

modern castings

MAY 1958

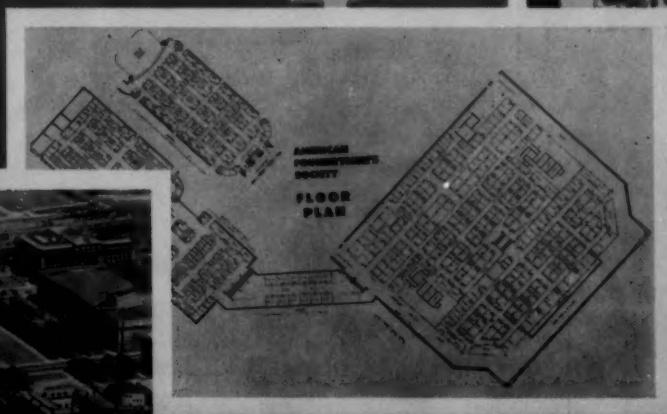


OFFICIAL CONVENTION ISSUE

Official
PROGRAM

Official
GUIDE TO
EXHIBITS

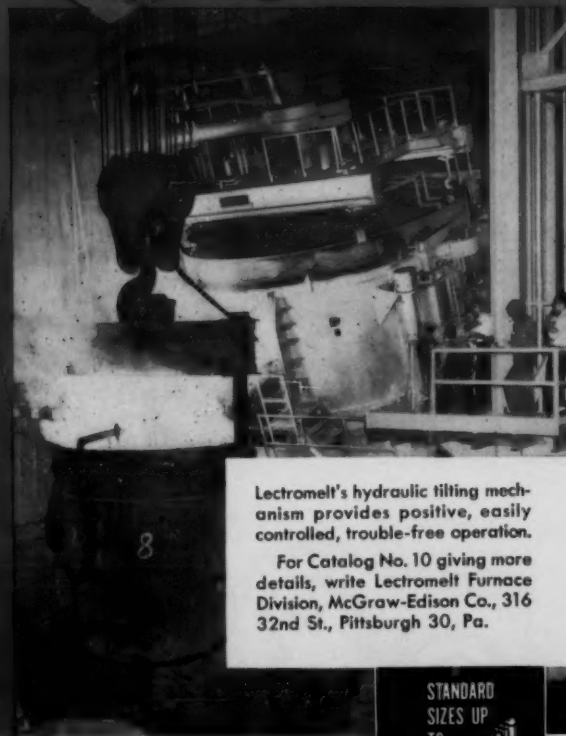
Official
AWARDS



WORK GOES FAST and SMOOTHLY with *Lectromelt** FURNACES

Right: Labor-saving top charging
lets a Lectromelt Furnace
get to work fast.

Below: With a Lectromelt Furnace,
you can crowd on the power while
holding close control on quality.



Lectromelt's hydraulic tilting mechanism provides positive, easily controlled, trouble-free operation.

For Catalog No. 10 giving more details, write Lectromelt Furnace Division, McGraw-Edison Co., 316 32nd St., Pittsburgh 30, Pa.

*REG. T. M. U. S. PAT. OFF.

Lectromelt

Circle No. 911, Page 7-8

future meetings and exhibits

MAY

April 27-May 1 . . American Ceramic Society, *Annual Meeting*. Penn-Sheraton Hotel, Pittsburgh, Pa.

April 27-May 2 . . The Electrochemical Society, *Technical Sessions*. Hotel Statler, New York.

1-8 . . American Society of Tool Engineers, *26th Annual Meeting & Convention*. Convention Center, Philadelphia.

5-6 . . American Institute of Mining, Metallurgical & Petroleum Engineers, Iron & Steel Div., *Conference on Properties of High-Strength Steel*. Penn-Sheraton Hotel, Pittsburgh, Pa.

8-9 . . Refractories Institute, *Annual Meeting*. The Homestead, Hot Springs, Va.

8-10 . . American Material Handling Society, *Western Material Handling Show*. Great Western Exhibit Center, Los Angeles.

12 . . National Castings Council Cleveland Athletic Club, Cleveland.

12-16 . . American Society for Metals, *1st Southwestern Metal Congress & Exposition*. State Fair Park, Dallas, Texas.

13 . . Metallurgical Associates, Inc., *Sales Clinic*. Robert Treat Hotel, Newark, N. J.

14-16 . . National Industrial Sand Association, *Annual Meeting*. The Homestead, Hot Springs, Va.

19-20 . . Non-Ferrous Founders' Society, *Annual Meeting*. Carter Hotel, Cleveland.

19-20 . . Southern Research Institute, *Conference*. Dinkler-Tutwiler Hotel, Birmingham, Ala.

19-23 . . AFS 62d *Annual Castings Congress & Foundry Show*. Public Auditorium, Cleveland.

21-22 . . American Iron and Steel Institute, *Annual Meeting*. Waldorf-Astoria Hotel, New York.

25-29 . . Air Pollution Control Association, *Annual Meeting*. Sheraton Hotel, Philadelphia.

27-29 . . American Institute of Mining, Metallurgical & Petroleum Engineers, Ni-



agara Frontier Section, *Reactive Metals Conference & Exhibit*. Statler-Hilton Hotel, Buffalo, N. Y.

JUNE

1-6 . . Columbia University, *Industrial Research Conference*. Arden House, Columbia University, New York.

4-5 . . Magnesium Association, *Symposium*. Aeronautical Sciences Bldg., Los Angeles. *Given jointly with Society of Aircraft Materials and Process Engineers*.

5 . . AFS Division Meetings, Executive and Program & Papers Committees, *Annual Review*. Sherman Hotel, Chicago.

6 . . AFS Technical Council, *Annual Meeting*. Sherman Hotel, Chicago.

9-10 . . Malleable Founders' Society, *Annual Meeting*. The Homestead, Hot Springs, Va.

9-12 . . American Society of Mechanical Engineers, *National Materials Handling Conference*. Public Auditorium, Cleveland. *Held in conjunction with Materials Handling Exposition*.

9-13 . . *International Automation Exposition & Congress*, Coliseum, New York.

12-13 . . AFS 15th Annual Chapter Officers Conference. Hotel Sherman, Chicago.

15-19 . . American Society of Mechanical Engineers, *Semi-annual Meeting*. Statler Hotel, Detroit.

18-28 . . Iron and Steel Institute, *International Meeting*. Belgium and Luxembourg.

19-21 . . AFS 3d Annual Foundry Instructors Seminar. Case Institute of Technology, Cleveland.

21-24 . . Alloy Casting Institute, *Annual Meeting*. The Homestead, Hot Springs, Va.

22-27 . . American Society for Testing Materials, *61st Annual Meeting*. Hotel Statler, Boston.

23-25 . . Investment Casting Institute, Spring Meeting. Occidental Hotel, Muskegon, Mich.

JULY

21 . . AFS T&RI Trustees, *Annual Meeting*. Union League Club, Chicago.

22-23 . . AFS Finance Committee, *Annual Meeting*. Union League Club, Chicago.

AUGUST

7 . . AFS Executive Committee, *Special Meeting*. Sherman Hotel, Chicago.



new from . . . BAROID

PETRO BOND

Bonds Sand WITHOUT Water

for . . . Precision Casting with
Conventional Foundry Equipment



PETRO BOND* by BAROID is a formulated bonding agent that bonds sand with the use of *oil* instead of *water*. The PETRO BOND sand contains oil in place of water . . . needs much less venting . . . permitting use of much finer sands with lower permeability than allowable with water sand molds. This means *precision castings* . . . using all ordinary foundry equipment.

Fifteen times less gas is generated in a PETRO BOND sand mold than in water bonded sand and less oil is used in PETRO BOND sand than water in conventional green sand mixes.

Foundries using PETRO BOND in both heap and complete sand systems have all reported definitely superior castings with their standard equipment.

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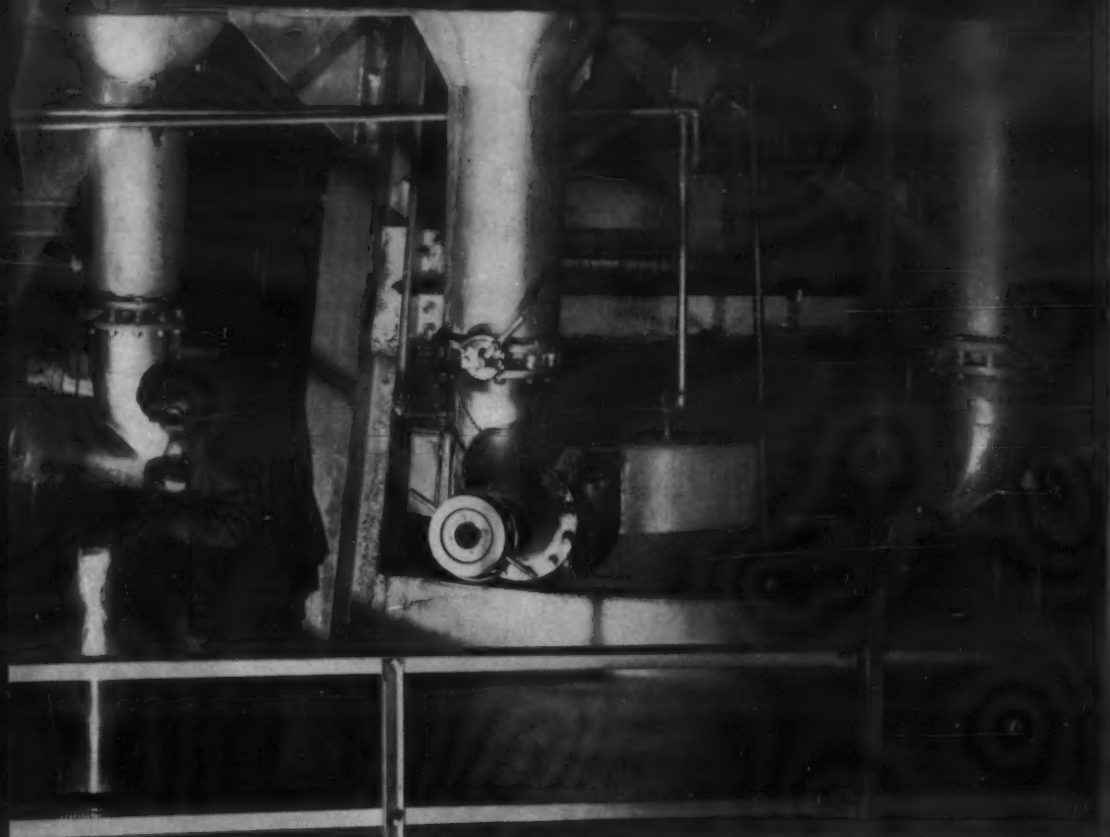
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Visit BAROID at Arena booth 414
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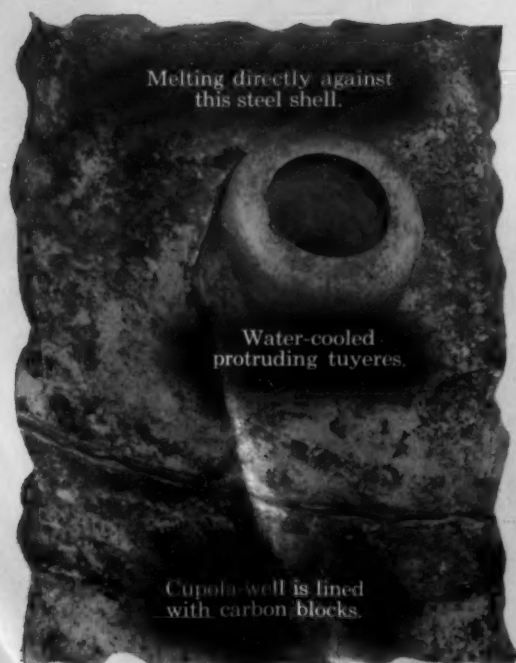


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The 9th Installation Already in Operation!



Melting directly against
this steel shell.

Water-cooled
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TV closed-circuit telecast of high-production melting!
Televised operations will originate in the Foundry
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show guests, live and direct, each day of the
Show — May 19 thru 23, Modern booths 1622 thru
1723 in Upper Lakeside Hall...

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PORT WASHINGTON, WIS.

AUGUST

7 . . . AFS Executive Committee, *Special Meeting*. Sherman Hotel, Chicago.

7-8 . . . AFS Board of Directors, *Annual Meeting*. Sherman Hotel, Chicago.

SEPTEMBER

10-11 . . . American Die Casting Institute, *Annual Meeting*. Edgewater Beach Hotel, Chicago.

22-23 . . . Steel Founders' Society of America, *Fall Meeting*. The Homestead, Hot Springs, Va.

23-26 . . . Association of Iron and Steel Engineers, *Exposition*. Public Auditorium, Cleveland.

29-Oct. 3 . . . Association Technique de Fonderie de Belgique, *25th International Foundry Congress*. Brussels and Liege, Belgium.

OCTOBER

5-8 . . . National Association of Corrosion Engineers, *Annual Meeting, Northeast Regional Division*. Somerset Hotel, Boston.

8-10 . . . Gray Iron Founders' Society, *Annual Meeting*. Sheraton Park Hotel, Washington, D. C.

13-18 . . . National Industrial Sand Association, *Semi-annual Meeting*. The Greenbrier, White Sulphur Springs, W. Va.

15-16 . . . AFS Michigan Regional Foundry Conference. University of Michigan, Ann Arbor, Mich.

16-17 . . . AFS All Canadian Regional Foundry Conference. Royal Connaught Hotel, Hamilton, Ont.

16-18 . . . Foundry Equipment Manufacturers Association, *Annual Meeting*. The Greenbrier, White Sulphur Springs, W. Va.

17-18 . . . AFS New England Regional Foundry Conference. Massachusetts Institute of Technology, Cambridge, Mass.

27-31 . . . American Society for Metals, *National Metals Exposition & Congress*. Public Auditorium, Cleveland.

30-31 . . . AFS Purdue Metals Casting Conference. Purdue University, Lafayette, Ind.

31-Nov. 1 . . . AFS Northwest Regional Foundry Conference. Multnomah Hotel, Portland, Ore.

modern castings

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AUTOMATION

A preview of your future foundry is disclosed in this issue of Modern Castings by the article — "The Foundry of Tomorrow Is Here Today." This foundry, owned by George Fischer Ltd., in Schaffhausen, Switzerland, represents the epitome of mechanization and automation in the metalcasting industry. Only nine men per shift are required to operate this plant, capable of producing 36,000 tons of malleable iron per year. These men are aided by a million dollars' worth of equipment for sand handling, sand conditioning, molding, pouring, cooling and shakeout — all integrated into precision sequence by mechanization and automation.

One can't help but realize that it is the uninteresting, repetitious, back-breaking foundry jobs that are being assigned to the stupid robots of automation. Man is being emancipated from routine so he can utilize his inherent intelligence and imagination on his job.

Automated machines are working longer hours. Many 24 hours a day, seven days a week. Their only ailments are mechanical failure and technological obsolescence.

Although there is an underlying suspicion and resentment among many groups toward automation because of the workers displaced by robots, the long-term impact of automation will be to create new jobs, new opportunities, new skills. This negative attitude is decadent in the light of past industrial experience. We now produce twice as much with each hour's labor as produced just prior to World War I and four times as much as produced in the 1870's.

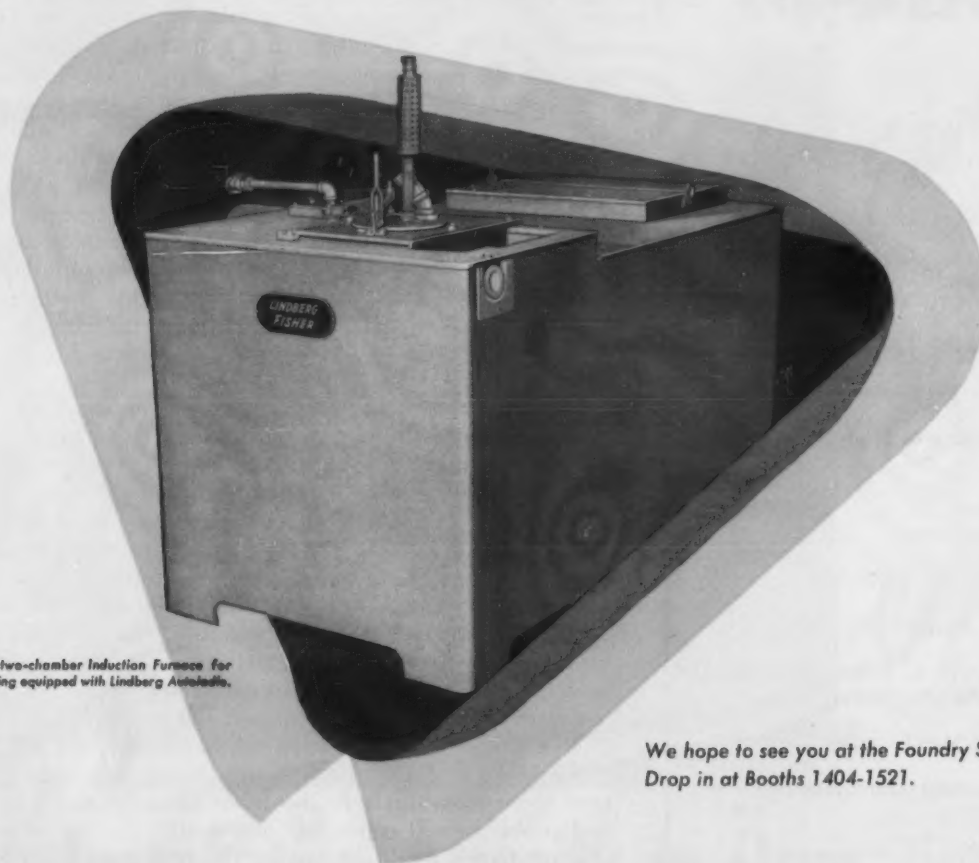
Reliable sources have developed figures that indicate the United States will require an estimated 40 per cent more goods and services by 1965 though it will have only 14 per cent more individuals in the labor force. Automation can and probably will solve this dilemma.

"Automation could be one of the biggest surprise packages in the technological grab bag, as far as the foundry industry is concerned." These are the exact words used by Clyde Williams, former director of Battelle Memorial Institute, in a recent speech. Mr. Williams went on to say, "Automation tends to generate an extremely high rate of obsolescence of capital equipment. A virtual replacement of the entire capital plant of America within the next 20 years because of automation has been predicted as a possibility. The foundry industry will benefit from this business. Foundries will also feel the effects of obsolescence of facilities and be forced to automate."

An intimate factor in this productivity growth of the foundry industry is the material handling equipment. This equipment serves as the spine and circulatory system that keeps materials on the move while foundrymen stand still. The automated George Fischer foundry could not have become a reality without mechanized roller conveyors, belt conveyors, chain conveyors, elevators and transfer units to deliver raw materials to sand preparation and molding stations; and to carry finished molds through the pouring department to cooling and shakeout.

Automation is here — today — to stay.

Here's the ideal combination for casting aluminum automatically



Lindberg-Fisher two-chamber Induction Furnace for melting and holding equipped with Lindberg Automatic.

We hope to see you at the Foundry Show.
Drop in at Booths 1404-1521.

Do you die-cast aluminum? Then take Lindberg's famous two-chamber induction melting and holding furnace, add "Little Joe" Lindberg's new automatic pump, and you'll have the most efficient automatic combination anywhere. The Lindberg-Fisher two-chamber furnace *melts* in one chamber, *holds* metal at precisely the right temperature in the other chamber, and "Little Joe" automatically delivers exactly the right size shot to the casting machine. With this combination all handling of molten metal is eliminated, perfect control of metal temperatures and shot size is maintained, and all automatically. For safer, more economical, more precise handling of aluminum or any non-ferrous metals or alloys better see Lindberg. Just get in touch with the Lindberg plant or the Lindberg Field Representative in your locality, or write Lindberg-Fisher Division, Lindberg Engineering Company, 2440 West Hubbard St., Chicago 12, Illinois. Los Angeles Plant: 11937 S. Regentview Ave., at Downey, California.



LINDBERG

heat for industry

have you read . . . ?

New periodicals and books

United States Department of Commerce, Ofc. of Technical Services, **Attaching Thermocouples by Capacitance Welding**, PB 121901. 5 p. Price \$0.50.

A method for the attachment of thermocouples to workpieces with the wires individually welded to the piece by discharging a bank of charged capacitors. Weld characteristics are controlled by means of a potentiometer. Operates off standard power supply.

United States Dept. of Commerce, Ofc. of Technical Services, **Minutes of Physical Metallurgy Symposium**, PB 131105 65 p. Price \$2.00.

Open discussion on a dozen pertinent papers. List of 150 firms and their representatives. Conference was under the auspices of Ordnance Corps, U. S. Army, Metallurgical Advisory Committee on Titanium.

Grinding Wheel Specifications for Grinding Machines, 140 p. 1950. Grinding Wheel Institute, 2130 Keith Bldg., Cleveland 15, Ohio.

Serves as a reference and guide to wheel requirements and spindle speeds. Illustrates dimensions for both standard and special shapes, with source of supply. Cones and plugs are classified as well as wheels.

Sisco, Frank T. (ed.), **Engineering Metallurgy**, by the Committee on Metallurgy. 516 p. c1957. Pitman Publishing Corp. New York.

A collaboration by some forty professors in the field. Besides an index each chapter is broken down in the table of contents; e.g., Chapter 1. Metallurgy and Engineering.

1.1 Metallurgy as an Art

1.2 Metallurgy as a Science

1.3 Metallurgy and Engineering

Subsequent chapters have 10 to 15 subheads. Some of the 23 chapter headings are as follows:

Factors affecting engineering properties, Phase Diagrams and the Simple Alloy Systems, Heat Treatment of Alloys by Precipitation, Machinability . . . and Deep-drawing Properties, Corrosion and Oxidations, Effect of Temperature on Mechanical Properties of Metals, Cemented Hard Carbides, The Construction of Steel, etc.

Questions at the end of each chapter provoke further thought and discussion.

National Open Hearth Steel Commit-

tee, **Deoxidation of Steel**, a Memorial Volume to C. H. Herty, Jr. 659 p. c1957. American Inst. of Mining, Metallurgical, and Petroleum Engineers, New York.

A collection of significant papers on the physical chemistry of steelmaking written by Mr. Herty and his colleagues. Included is a directory of his associates and a biographical sketch of the man by G. R. Fitterer. Deoxidation through the use of silicon, aluminum, and magnesium-silicon alloys, are among the papers collected.

Stricklen, Ray, **Which Finish for Zinc Die Castings?** Product Engineering, March 3, 1958, p. 59.

A guide to mechanical, chemical, plating and painting methods. Charts mechanical, chemical, electroplating, and organic finishes as to purpose, appearance, resistance to the elements, preparation required, application, relative cost, and government specs, if any.

Two-Shift Cupola Operation with Water-Cooled Cupola

■ Internal water cooling, using independent water jackets or water glands in the cupola melting zone, has enabled the Neenah Foundry Co., Neenah, Wis., to operate a No. 8 cupola through two shifts.

Company officials R. J. Aylward and J. Goudzwaard stated before the 1957 Wisconsin Regional Conference that they decided on water jackets for the following reasons:

1) **Cost.** Jackets are a cheap method by which to adapt to water cooling. They require no extensive shell changes necessary in external water cooling.

2) **Installation time.** The jackets were installed over a weekend at no loss in productive time.

3) **Low operating cost.** The system used between 60-80 gal of water per minute at a cost of around eight dollars per day. The water is then used to flush slag from the front slagging spout and is also used in the emission collectors on top of the stack. Jacket life is good, and maintenance costs are low.

This installation changed cupola operation to melting on a water-cooled surface through most of the heat. This resulted in a serious silicon loss through the last half of the heat; slag analysis showed very high oxidation. This problem was overcome by setting limits on blast volume, 8000 cfm minimum to 9000 cfm maximum. Tuyere ratio was reduced to 12.5 per cent. Analysis leveled off throughout the heat and the severe silicon loss problem was eliminated.

VOLCLAY BENTONITE

NEWSLETTER No. 56

REPORTING NEWS AND DEVELOPMENTS IN THE FOUNDRY USE OF BENTONITE

SURGING of metal

Scrap caused by the surging of metal is often described at the inspection bench as a "cold shut", "poured short", or a steel term, "hollow".

Few ever view such a casting defect as one caused by surging. The photo was judged as "poured short". It may be, but surging causes similar defects. The casting is a brake housing, weighing 25½ lbs. and the defect was caused by careless pouring.

Surging is actually created by inaccurate pouring. It is a human error.

Fast and hard pouring may be responsible for more surging than any other cause.

When a gating system fills so rapidly that metal overflows, it is quite likely that the operator may interrupt pouring which creates surging. **Irregular pouring, or intermittent pouring, is an equal cause.**

In many cases, it is more likely the inspection bench may term the defect as "poured short" or "misrun".



Photo from: "It's Not All Sand."

Similarly, other casting defects occur which are caused by human errors. Incorrectly, certain surging defects are misinterpreted as mold-gas defects. Therefore, sand technicians become involved in curing a defect beyond their control.

By encouraging foundry control and by using products that insure good casting quality, less scrap is produced.

Use time tested products such as Volclay, Panther Creek, Five Star Wood Flour and KleanSurf Iron Ore Oxide. **Ask for, and you shall receive,** American Colloid's technical help and guidance in overcoming such irregular defects.

WRITE FOR REPRINT . . . "IT'S NOT ALL SAND!"

Preprint No. 55-101 AFS Transactions by C. A. Sanders and Nathan Levinsohn

AMERICAN COLLOID COMPANY

SKOKIE, ILLINOIS • PRODUCERS OF VOLCLAY AND PANTHER CREEK BENTONITE

Report on the All-New Model H-25 **PAYLOADER®**

by G. A. Gilbertson,
President of The Frank G. Hough Co.



Recently I had the pleasure of personally delivering the 10,000th production model HA "PAYLOADER" to our Distributor in the metropolitan Chicago area.

Because our company pioneered the first unit-designed, rubber-tired front-end loader and because this quantity of 10,000 of a single model is more than all other manufacturers combined have produced, we were justifiably proud of our accomplishment and the acceptance of our product by industry.

Inasmuch as we anticipate a continued demand for this model HA, we plan to continue its production, even though we are now introducing a completely new machine, the model H-25.

More "Payloader" Pioneering

This new H-25 "PAYLOADER" is in a class by itself as far as capacity, productive ability and features are concerned—a quality machine in *every* sense of the word. It will handle more tonnage per hour and at less cost per ton than any front-end loader near its size.

What is so different about the new H-25?

More Capacity and Maneuverability

In terms of capacity alone, it is outstanding . . . the only machine with a *carry capacity* of 2,500

lbs., at average operating speeds of 4 m.p.h. Thus, for handling materials weighing 125 lbs. per cu. ft., it can have a bucket with 20 cu. ft. S.A.E. capacity rating. Larger and smaller buckets are available for lighter and heavier materials.

With a bigger and heavier unit having more capacity, you would logically expect it would need more room to operate. On the contrary, it actually has a turning radius (measured to the outside rear hub) which is **LESS** than ANY other rubber-tired tractor-shovel.

The H-25 Has Extra "built-in" Strength

Some operators will always push equipment to extremes, regardless of its recommended capacity. This abuse will inevitably result in extra maintenance and even failure. That is why we have engineered extra strength and stamina throughout the H-25 . . . for your protection.

What About Individual Features?

There are dozens of them! The new power-shift transmission is a two-speed, full-reversing type with new matched torque converter that give the ultimate in speed and ease of operation. Power-steering adds further to handling ease.

This new "PAYLOADER" is equipped with sealed, self-adjusting brakes and is the only unit of this

class offering this important feature.

It has a maximum dumping height that is 6½ inches higher than the average of other loaders now being offered in this general capacity range. The 44 HP gasoline engine has overhead valves for better performance and wet sleeves for easier maintenance. LPG (liquified petroleum gas) and diesel power are available.

Dig-ability?

When it comes to digging power, the H-25 gives you 4,500 lbs. of breakout force and, like other "PAYLOADER" front-end loaders, provides a bucket tip-back of 40 degrees, *at ground level!* As the bucket raises, a further tip-back to 65 degrees helps retain maximum loads.

Protective Features

If you are concerned with dust and dirt like most chemical, fertilizer and foundry operators are, you will appreciate the extra protective features engineered into the H-25. For example, the engine is afforded maximum protection with triple air cleaners—a precleaner and dual oil-bath air cleaners. The hydraulic system is fully filtered and is the closed, pressure-control type.

The sealing of the majority of all pivot points reduces maintenance. Transmission and torque converter oil is cooled by the engine radiator cooling system and is fully filtered.

Other Features

This new H-25 is equipped with high-traction differential which automatically transfers more torque to the drive wheel with the best footing when slippage is encountered.

The fuel tank of this new "PAYLOADER" has sufficient capacity for eight full hours of operation and eliminates the need for refueling during any shift.

There are many, many more features which we think you will be interested in. The many interchangeable attachments now available for the model HA "PAYLOADER" can also be used on the new H-25. Contact your "PAYLOADER" Distributor for full details. Ask him about Hough purchase and lease plans, too. The Frank G. Hough Co., 711 Sunnyside Ave., Libertyville, Ill.

5-A-2

You can see the model H-25 in Cleveland at the **FOUNDRY SHOW**, May 19-23 and **NATIONAL MATERIALS HANDLING SHOW**, June 9-12.



Modern Materials Handling Equipment
THE FRANK G. HOUGH CO.
LIBERTYVILLE, ILLINOIS
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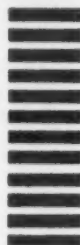
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Investment Casting Field Using Plastic and Mercury

■ Plastics and frozen mercury, increasingly used as pattern material in conjunction with investment casting, have accounted for the increase in size of castings made by this process. Until recently, investment castings have been limited in size to under five lb; today, castings weighing over 300 lb are not uncommon.

Initial investment pattern material, wax, is expensive, and some is lost in processing. It costs nearly a dollar a lb, whereas polystyrene or other suitable plastics range from 30-40 cents a lb. A higher rate of production is possible with plastic patterns, although wax and frozen mercury are more satisfactory for intricate or complicated designs.

Frozen mercury is relatively new as a pattern material, and is more expensive since refrigeration (-70 to -135 F) is required.

Regardless of the medium used, patterns are prepared in a similar manner. A master metal pattern is made, from which a split pattern die is prepared of metal, hard rubber or plaster. Flexible, synthetic rubber dies are being used more and more; this material permits the pattern to be removed even though off-sets or back draft are present.

Liquid wax, plastic or mercury is poured or injected into the die to form a pattern. The hardened pattern is inspected for flaws, and then invested (dipped into a "slurry" plaster-like material) until well covered. The mold is formed by further coating with a refractory mixture.

■ Condensed from *Recent Developments in the Ferrous Foundry Industry*. Small Business Administration, Washington, D. C. Circle C, page 7-8, for copy of this informative report.

modern methods for modern castings readers

■ Send today for your free copy of the convenient time-saving 1957 index of last year's issues of MODERN CASTINGS. This simple cross-reference will enable you to find material with a minimum of effort.

For your free copy, circle K, Reader Service Card, page 7-8.

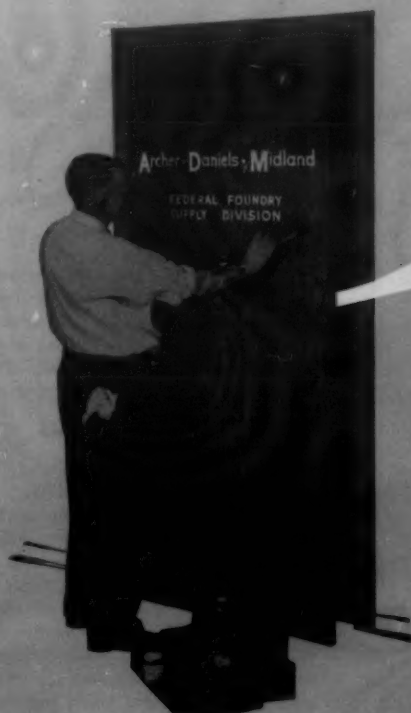
If you are aiming toward better castings and higher profits, you might wish to listen in on a...

Public Discussion about a Private Matter

(the merger of ADM and FEDERAL)

Because the purchase of corporations is usually conducted behind scenes, people naturally wonder what is going on. Customers of both companies question whether service will be the same; they wonder about product quality; they ask if service personnel will change, etc.

These are reasonable uncertainties. We believe, however, they should be promptly clarified. Therefore, we have chosen to answer publicly the questions frequently asked:



QUESTION: Why the merger? Who is the purchasing company?

ANSWER: ADM purchased the complete plants and facilities of Federal on August 1, 1957. The new company name is Archer-Daniels-Midland Company, Federal Foundry Supply Division. The merger stemmed from: (1) the industry's growing need for greater technical field service, (2) the need of a single source for a complete line of highest quality foundry supplies, (3) ADM's desire to couple their expanding line of products with unparalleled application know-how.

QUESTION: Will all Federal Foundry Supply Company products still be available?

ANSWER: Yes. In fact, we hope to expand the product line. The combination of ADM and Federal products makes available the country's most complete line of foundry supplies "under one roof." Whatever the problem or process, ADM has "no axe to grind" for any one system in preference to another. The prescription can fit the diagnosis.

QUESTION: Who will back up existing Federal purchase agreements, contracts, etc.?

ANSWER: ADM will guarantee 100% performance in living up to agreements made between Federal Sales and Service personnel and their customers prior to the merger.

QUESTION: Who will represent Federal supplies in the field?

ANSWER: The Federal Sales and Service organization has been combined with the ADM field representatives with as few territorial changes as possible. Where changes do exist, every effort is being made to improve your service. The technical knowledge in all district offices has been broadened by the combined knowledge of the Federal and the ADM sales-service teams.

QUESTION: Will prices remain the same?

ANSWER: The price structure as well as the pricing philosophy of ADM will prevail. It has long been our policy to price products as low as is consistent with high quality, competent customer service, and a continuing research program.

Our intention is to provide maximum product value for the price and to encourage profitable application of the product by providing skillful technical assistance.

ADM and Federal customers will now save through lower distribution costs, lower freight on combination shipments, and in "shopping" time.

QUESTION: Will ADM maintain high product quality in the Bentonites, core washes, sea coals, and plumbagos?

ANSWER: All Federal plants, facilities—and most important—people are now a part of ADM. Added to these are the research and control laboratories of ADM, three of which have recently been installed in Federal plants to insure continuation of product quality and uniformity. Also, ADM has just completed construction of the world's most modern Bentonite processing plant, augmenting Federal's previous large capacity. Customers can thus be assured of continuing close attention to their requirements.

We hope this clarifies the major points of the merger as it concerns our business relationship, and we welcome any suggestions and encourage your comments in the interest of continuing improvement of customer service.

These are some of the better-known trade names now identified by the famous Archer quality trademark...

GREEN BOND H-J High-gelatinating Bentonite	LINOIL Core Oils	FEDERAL Plumbagos
GREEN BOND L-J Low-gelatinating Bentonite	INDUCTOL Fast-baking core oils	FEDERAL Core Pastes
WYOBOND Pure Western Bentonite (medium gelatinating)	LIN-O-SET Air-setting core binders	ROCKET-BAKE Super-speed Liquid Core Binder
CROWN HILL Sea Coal	ADMIREZ Foundry Resins	LIN-O-CEL Sand Stabilizer
FEDERAL Sand Stabilizers	ADCOSIL CO: Binders	FREFLO Parting Compound
	FEDERAL Core Washes	SAN-BLO Foundry Equipment



Archer-Daniels-Midland company
FEDERAL FOUNDRY SUPPLY DIVISION • 2151 West 110th Street, Cleveland 2, Ohio

Quality of melt masking your profit picture?



Chief Keokuk's masks usually meant trouble for the spooks. But Junior's hop to real quality! While Princess Wenatchee toms the traveling music, he's bobbing about 'neath a mask of his own . . . one that's bound to bounce the evil spirits for good!

HIGH COSTS AND POOR QUALITY ARE REAL DEMONS

Send 'em scampering with Keokuk Silvery Pig Iron, the superior form of silicon introduction that helps foundries and steel plants control the uniformity of every melt. Handle by magnet, furnace-charge by weight, or count the pigs for equal accuracy. Aluminum producers, choose Keokuk Silicon metal every time!

Keokuk Electro-Metals Company, Keokuk, Iowa;

Wenatches Division, Wenatchee, Washington



When you think of SILICON,
think of KEOKUK!

SALES AGENT: MILLER AND COMPANY
332 S. Michigan Avenue, Chicago 4, Illinois
3504 Carew Tower, Cincinnati 2, Ohio
8230 Forsyth Blvd., St. Louis 24, Missouri

Keokuk Silvery Pig—the superior form of silicon introduction—is available in 60 and 30 lb. pigs and 12½ lb. piglets in standard analysis or alloyed to your specifications. Silicon metal and ferro-silicon are supplied in standard sizes and analyses.

Circle No. 918, Page 7-8

Build an idea file for plant improvements.
The post-free cards on page 7-8
will bring more information on these new . . .

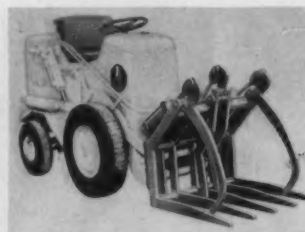
products and processes

CO₂ SHELL MOLDS . . . for semi-precision casting technique are suitable for most metals. Combines close-tolerance aspects of shell molding with time, labor, and equipment saving features of CO₂ process. Little investment needed to use new process which requires only a CO₂ gas supply, gassing heads, inexpensive sodium silicate binder and patterns.

Gassing with CO₂ hardens mold in 15-30 sec compared to 40-75 sec for shell molds. Operations are carried out at room temperature allowing use of wood, aluminum or plastic patterns. **National Cylinder Gas Co.**

*For Manufacturer's Information
Circle No. 801, Page 7-8*

HYDRAULIC GRAB ATTACHMENT . . . for tractor shovel designed for fast loading, carrying and dumping of scrap, barrels and drums. Company officials state that the attachment has reduced scrap handling



time as much as 70 per cent. Attachment completely hydraulically controlled, with "kick-arm" which assures fast, clean discharge of material when dumping. Models have 1500 and 2250 lb capacity, both with grab opening of 60 in. **Frank G. Hough Co.**

*For Manufacturer's Information
Circle No. 802, Page 7-8*

FORK-LIFT TRUCKS RENTAL . . . service, in addition to other materials handling equipment, is available for firms in metropolitan New York, northern New Jersey, and Connecticut. Assets include a fleet of 550 fork trucks and 30 maintenance vehicles. The company assumes responsibility for maintenance and servicing of machines, including parts replace-

ment while equipment is on rental. **Clark Equipment Co.**

*For Manufacturer's Information
Circle No. 803, Page 7-8*

NON-FERROUS METAL BONDING . . . process which bonds, through unique eutectic reaction, aluminum to aluminum, and other non-ferrous metals, similar or dissimilar, to each other, is said to join two die castings together in a permanent bond. The material, in wire form, is available in three forms; for joining exposed joints; for broader areas; and for low-temperature joining and large surfaces. **Intertectics Inc.**

*For Manufacturer's Information
Circle No. 804, Page 7-8*

SHELL MOLD . . . and core machines feature multiple station indexing available with 2, 4, 5 or 6 stations. Uniform density and controlled shell thickness and accuracy are claimed for airstream blowing method. Rapid and continuous production results from automatic preset time cycles. Fast stripping with shell removal and transfer features are aid to productivity and efficiency. Multiple oven stations allow controlled cure time at high production. **Osborn Mfg. Co.**

*For Manufacturer's Information
Circle No. 805, Page 7-8*

AUTOMATIC SAW SHARPENING . . . machine for sharpening all circular metal saws 1/2-14 in. in diameter, from the finest teeth up to two per in. Claimed to sharpen saws used in cutting steels, brass, copper, bronze, aluminum and plastics. Company says machine will cut in all new teeth or change number of teeth to more or less per in., and will sharpen saws again and again. Attachments available for sharpening hole saws, hack saws and band saws. **Hamco Machines, Inc.**

*For Manufacturer's Information
Circle No. 806, Page 7-8*

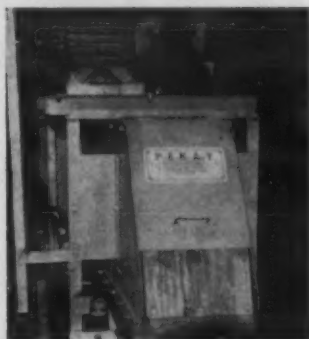
PATTERN PANELS . . . of industrial laminate said to offer strength and durability to pattern making industry. Lignin-resin material has high dimensional stability, high density,

■ Details on these products and processes are available to MODERN CASTINGS readers. See page 7-8.

weighs half as much as Al, and has uniform hardness. Can be shaped, drilled, sanded, beveled, and laminated to any thickness. *Masonite Corp.*

For Manufacturer's Information
Circle No. 807, Page 7-8

SAND BLENDER . . . conditions sand by pre-mixing bonds with shakeout sands before moisture additions reduce flowability and hinder uniform distribution. When used to distribute clay prior to moisture addition, the mixer is said to promote more uniform clay films on sand grains; also claimed to give a random distribution of grain



sizes. Mounted on customer's conveyor or belt with no alterations necessary, the mixer requires no elevator feed and is said to be completely installed in less than 25 man-hours. Units available in any size or tonnage. *Pekay Machine & Engineering Co.*

For Manufacturer's Information
Circle No. 808, Page 7-8

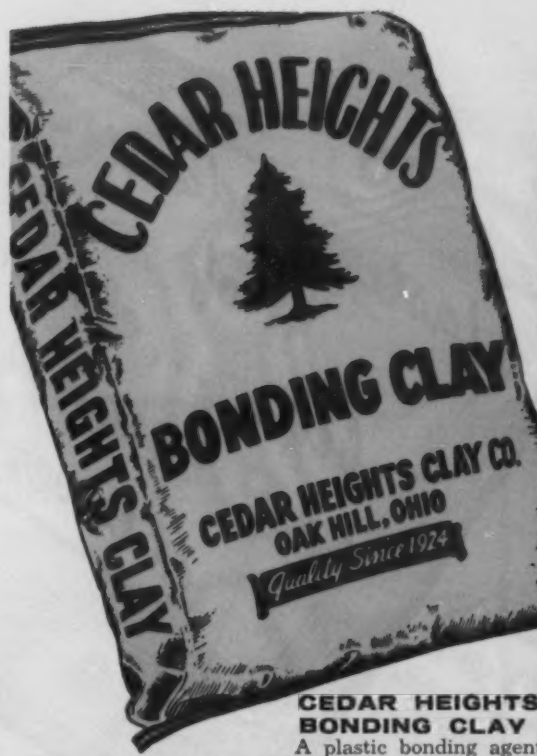
CASTING RESIN . . . may be cast at least 12 in. thick without excessive exothermic heat being generated, manufacturer claims. Cast patterns and shapes reach full strength in 24-28 hours, have compressive strength of 5000 psi, and are said to be easily machined. *Furane Plastics, Inc.*

For Manufacturer's Information
Circle No. 809, Page 7-8

BELT CONVEYOR SCALES . . . said to reduce maintenance over conventional type through simplified design. Weighs, controls, and totals free-flowing materials such as molding sand. Scale housing and gear box sealed against dust. All capacities available. *McDowell Co. Inc.*

For Manufacturer's Information
Circle No. 810, Page 7-8

INDICATES MOISTURE CONTENT . . . of a batch of molding sand during mulling cycle. Muller accessory claimed to permit operator to easily



CEDAR HEIGHTS BONDING CLAY
A plastic bonding agent produced in No. 8, 12, 16, 20, 30, and 50 meshes.



CEDAR HEIGHTS AIRFLOATED CLAY
Highly refined, artificially dried. Ground to 200 mesh.



CEDAR HEIGHTS FIRE CLAY
High in refractory value, smooth clean texture. Produced in No. 8, 12, 16 and 20 meshes.



for better castings

. . . start with clean molds made with sand containing superior Cedar Heights bonding agents.

These super-refined clays from the world's finest clay deposits help to produce molds with higher green strength . . . higher dry strength with a minimum of shrinkage . . . higher hot strength.

Castings peel clean with a fine finish . . . have fewer pinholes . . . less rejects.

For proof of Cedar Heights quality and performance make a test mold in your own laboratory or foundry operation. Contact your distributor or write for free test samples.

CEDAR HEIGHTS CLAY

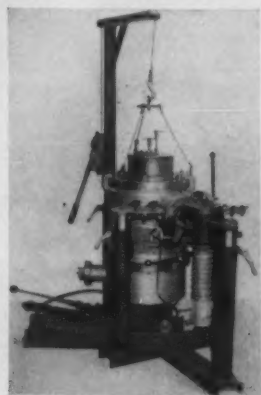


COMPANY

prepare sand of required moisture level best suited to produce molds for castings of uniform high quality, while reducing losses and cleaning costs. Records moisture content and temperature of sand. *Harry W. Dietert Co.*

*For Manufacturer's Information
Circle No. 811, Page 7-8*

LABORATORY VACUUM FURNACE . . . employs either resistance or induction heating to attain temperatures above 2000 C. Unit handles either vacuum or inert gas melting and heat treating of metals including melting, vacuum casting, annealing,



sintering, and crystal growing. Ceramic crucible and pouring spout are easily replaceable without chipping required in other furnaces of this type. Capacity of 10 lb of steel if crucible is tilt-poured, and 25 lb if bottom-plug pouring is used. *Vacuum Equipment Div., New York Air Brake Co.*

*For Manufacturer's Information
Circle No. 812, Page 7-8*

PORTABLE DUST COLLECTOR . . . easily moved on roller casters, said to adequately serve a number of machines not simultaneously operated. Dust particles separated by centrifugal force, and retained in dust pan and filter bag. Unit may be permanently installed or placed on a wall shelf to conserve space, weighs 70 lb. *Chicago Air Filter Co.*

*For Manufacturer's Information
Circle No. 813, Page 7-8*

HIGH TEMPERATURE MARKER . . . for marking castings to be subject to heat treating and annealing. Marks made when metal is cold remain legible to 2400 F. Withstands quenchings in oil or water; can be removed by use of pickling bath. *Markal Co.*

*For Manufacturer's Information
Circle No. 814, Page 7-8*

PORTABLE HARDNESS TESTER . . . tests inside and outside surfaces of castings without need for cutting test

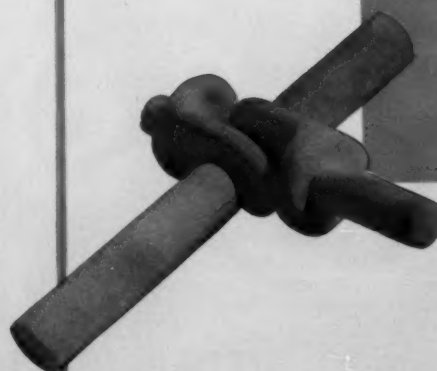


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foundry products

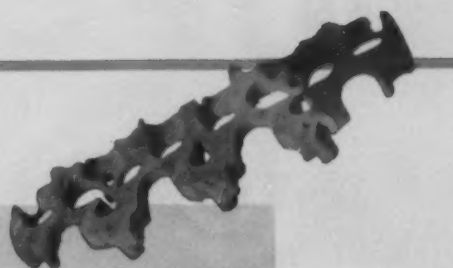
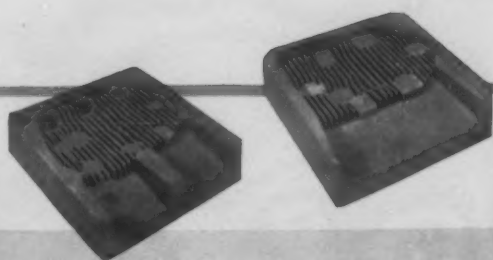
Every DELTA Foundry Product is backed by continuing and exhaustive laboratory research to safeguard quality and maintain absolute uniformity of the finished product. Every step in the manufacturing processes is under strict laboratory control and all raw materials must conform to rigid quality specifications.

Delta Oil Products Corp. not only pioneered the development of plastic-type core and mold washes but has continued to lead in the development of new and improved products for the production of better castings — faster and more economically.

Delta sales technicians are ready, at all times, to assist in the more effective and more economical use of core oils, core and mold washes and sand additives for increased efficiency and lower production costs.



Circle No. 920, Page 7-8



CORE AND MOLD WASHES:

FOR STEEL:

*Special Core and
Mold Wash Base
*SteelKoat
*PyroKoat-S
*SuperKoat
*ThermoKoat
*Z-Koat
*ZZ-Koat

FOR GRAY IRON AND MALLEABLE:

*GraKoat
*BlackKoat
*SuperKoat
*BlackKoat C-2
*BlackKoat C-4
*DriKoat B-3
*DriKoat B-5
*BlackKoat S-3
*PyroKoat-S
*PyroKoat-G

FOR ALL TYPES OF SAND CAST METALS:

*ThermoKoat
*Z-Koat
*ZZ-Koat
*SuperKoat

FOR NON-FERROUS METALS:

*NonferrousKoat
*SuperKoat
*GraKoat F
*DriKoat F

PARTING COMPOUNDS:

*Partex
*Super Partex
Liquid Parting
Liquid Parting Concentrates

*PART-RITE LIQUID PARTING

MUDDING & PATCHING COMPOUNDS:

*Slikite *Ebony

MOLD SEAL COMPOUNDS

*NO-VEIN COMPOUND

MOLD SURFACE BINDERS — Liquid

*DRI-BOND

*BONDITE

INGOT MOLDKOAT

250XX Powder
277XX Liquid

SURFACE HARDENERS FOR CORES AND MOLDS

258XX Spray Binder
Concentrate
Spray Binders — Liquid

SILICATE BINDER

292XX Excellent Collapsibility
270XX Good Collapsibility
285XX Fair Collapsibility
299XX Poor Collapsibility

GRIPRITE CORE PASTE

CORE ROD DIP OIL

CORE OILS

CO₂ BINDERS

LIQUID RESIN BINDERS:

155-X Fast-Dri
168-X Fast-Dri
191-XX Fast-Dri

FOR SHELL MOLDS

DELTA-Dietert Process
Binder 103XX
(For "D" process shell
cores.)

FOR SAND:

*Permi-Bond (sea coal
replacement)
*Sand Conditioning Oils
*96-B Sand Release Agent

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*A Foundry First — by Delta.

DELTA

DELTA OIL PRODUCTS CORP.

MANUFACTURERS OF SCIENTIFICALLY CONTROLLED FOUNDRY PRODUCTS

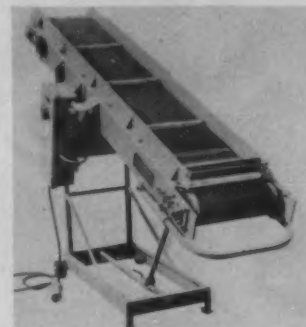
**MILWAUKEE 9,
WISCONSIN**

Details on these products and processes are available to MODERN CASTINGS readers. See page 7-8.

specimens. Can be held at any angle without affecting accuracy. Models for testing up to 12-in. dia or thickness. Hardness read directly from dials mounted on tester. *American Machine and Metals, Inc.*

For Manufacturer's Information
Circle No. 815, Page 7-8

PORTABLE CONVEYOR . . . of heavy duty construction for conveying castings and heavy materials



short distances. Adjusts in height and to any angle up to 45 degrees. Wheels permit rolling to location needed, but are said not to require blocking during operation of conveyor. Various lengths and widths available, with drives to meet individual needs. *May-Fran Engineering, Inc.*

For Manufacturer's Information
Circle No. 816, Page 7-8

LIGHT-WEIGHT SAFETY GOGGLES . . . in both welder's and chipper's models constructed with soft, vinyl plastic frames claimed to mold to the face, and to cut wearing fatigue and strain because of light weight. Fitted with removable rings and filter



lenses, the welder's model has light-proof, indirect ventilators to eliminate harmful light rays and glare. Pliable nose shields give added protection; frames fit over all prescription glasses with ease, according to manufacturer. *Glendale Optical Co.*

For Manufacturer's Information
Circle No. 817, Page 7-8

SMOOTH PATTERN SURFACE . . . permitting easy draw of wooden patterns from sand mold results from



Speed production of grey iron castings



EXCELLENT FLOWABILITY of Dexocor binder sand mix gives uniform structure throughout cores—and draws are made easily without sticking.

A large midwestern grey iron foundry finds that:

"Cores made with Dexocor baked through in 40 to 50 per cent less time—saving fuel dollars and permitting more flexible production scheduling. In addition, green cores, even with high stands or overhang, held perfect shape. Cracking of cores, gas defects and metal penetration were virtually eliminated."

—Dexocor offers other advantages: better moisture control, excellent flowability, quick, easy mixing, blowing, ramming, easy shake-out—especially when used with Mogul or Kordek binder.

Ask for detailed information and technical help in utilizing this new miracle binder. Contact our nearest sales office.

*Source on request.

DEXOCOR® Binder

Other fine products for the Foundry Industry: MOGUL® and KORDEK® Binders • GLOBE® Dextrines



CORN PRODUCTS SALES COMPANY
17 Battery Place, New York 4, N. Y.

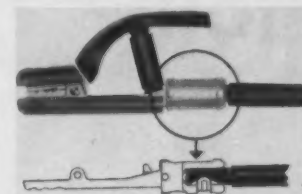
You are invited to Visit our Booth #114
and our Hospitality Suite at the Cleveland Hotel.

Circle No. 921, Page 7-8

new spray-on material. Surface is impervious to oils and other binders in core sands, and is claimed to be more resistant to wearing action of sand than shellac. *Krylon, Inc.*

For Manufacturer's Information
Circle No. 818, Page 7-8

ELECTRODE HOLDER . . . can be installed on welding cable in less than two min, company officials state. New connection allows use of larger sizes of cable than formerly possible by elimination of shim stock and pressure plate. To install, welder



strips cable jacket, inserts cable strands and tightens ball-point screw directly on cable strands. Said to eliminate heating problem common to most other types of connections, and to save many hours of maintenance time. *Tweco Products, Inc.*

For Manufacturer's Information
Circle No. 819, Page 7-8

GIANT PRECISION HOIST . . . can lift a 45-ton weight to a height of 103 ft. Full capacity load can be raised or lowered 0.008 in. when precision is needed; 992 ft of cable is wound on the drum, 6-1/2 ft long and 4 ft in dia. *R. G. LeTourneau.*

For Manufacturer's Information
Circle No. 820, Page 7-8

MELTING-HOLDING FURNACES . . . may be used for die casting, permanent mold casting and sand casting. Manufacturer claims return scrap may be charged back on sloping hearth, eliminating contamination of furnace with inserts. Fully automatic furnace contains bridged, ladle-out well. Radiant roof heating reduces melt loss. Furnaces are available in 1200-5000-lb. capacities of aluminum. *Sunbeam Corp., Industrial Furnace Div.*

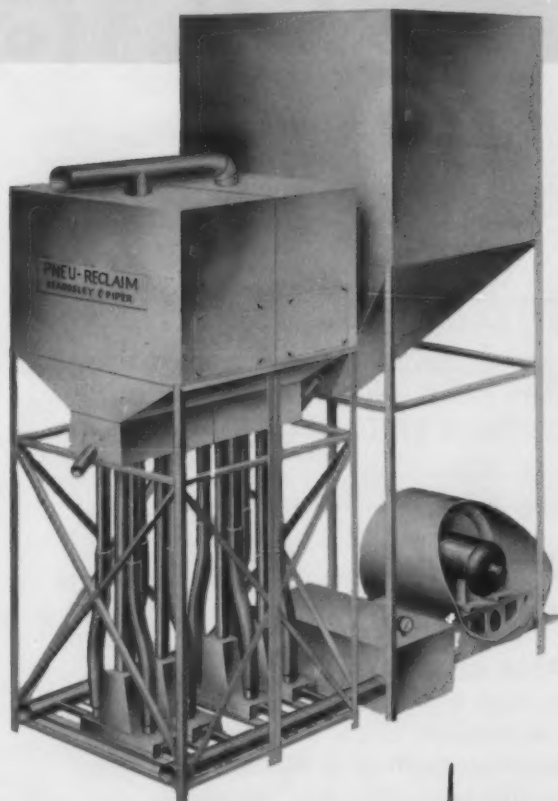
For Manufacturer's Information
Circle No. 821, Page 7-8

LABORATORY PRESS . . . controls mounting of metallographic samples automatically. Eliminates pumping needed to maintain constant pressure. Magnetic push buttons energize solenoids controlling travel of ram in molding assembly. Preheat chamber keeps preforms near melting point, ready for insertion into

Circle No. 922, Page 7-8

PROGRESS IN SAND PROCESSING

**B&P
PROGRESS
REPORT**



PNEU-RECLAIM

...FOR DRY SAND RECLAMATION
YOU CAN AFFORD!

- Cuts installation cost with package design
- Cuts operating cost with Dual-Jet Scrubbing
- Cuts maintenance cost with revolutionary, low-velocity operation
- Obsoletes all earlier units by capacity and quality performance

**NEW
FOR
'58**



MULBARO

- The only really portable muller
- Lowest initial cost by far
- Lowest operating cost—no sand rehandling
- Several barrows used with one mulling unit
- Fast, thorough preparation
- Molding Sand—Core Sand—Shell Sand—CO₂ Sand—Airsetting Sand

**NEW
FOR
'58**



LABORATORY MULBARO

- New plow design
- New tilting mechanism
- New large inspection door
- New operating convenience
- New streamlined design



SPEEDMULLOR

- Most capacity per square foot of floor space
- Most capacity per dollar invested
- Lowest operating cost
- Compact Speedmullor-Preparator units for maximum sand conditioning capacity in minimum space



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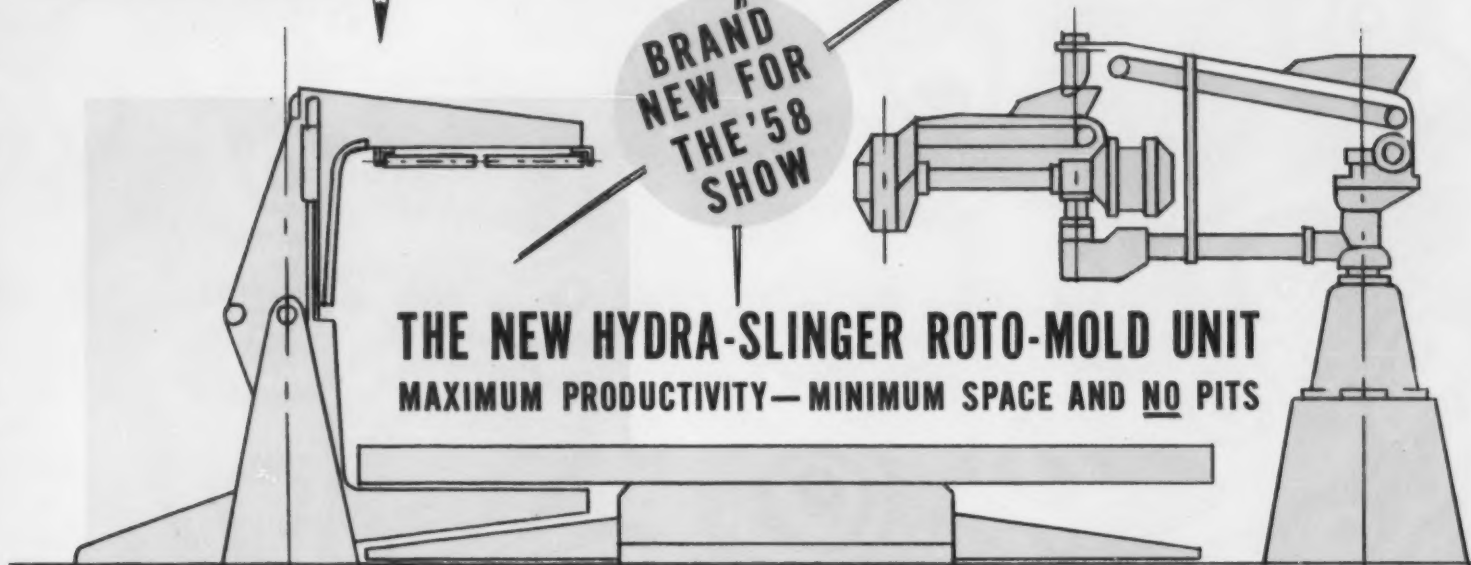
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REPORT**

PROGRESS IN MOLDING

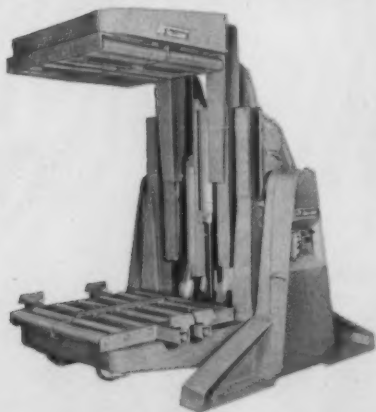
**BRAND
NEW FOR
THE '58
SHOW**

THE NEW HYDRA-SLINGER ROTO-MOLD UNIT

MAXIMUM PRODUCTIVITY—MINIMUM SPACE AND NO PITS



featuring the NEW ROL-A-DRAW



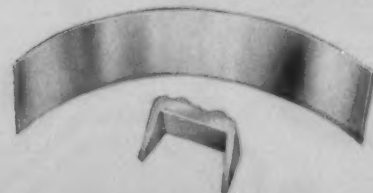
- Capacities to 12,000 pounds
- Compact, floor-mounted
- Fast, smooth rollover, accurate draw
- Fully automatic cycle . . . no errors
- And no pits

A NEW STANDARD OF PERFORMANCE

- No pits of any kind
- Faster, more accurate index
- More dependable
- Maximum productivity in minimum floor area
- Four-station production with one-station sand system
- Interlocking construction . . . it's really compact
- Multiple-station production for production and jobbing work

DIAMOND ALLOY TIPS AND LINERS

**NEW
FOR
'58**



- New high impact strength
- New precision
- New super abrasion resistance
- New higher hardness
- New heat treat
- New quality control

SEE THESE NEW DEVELOPMENTS AT THE

PROGRESS IN COREMAKING

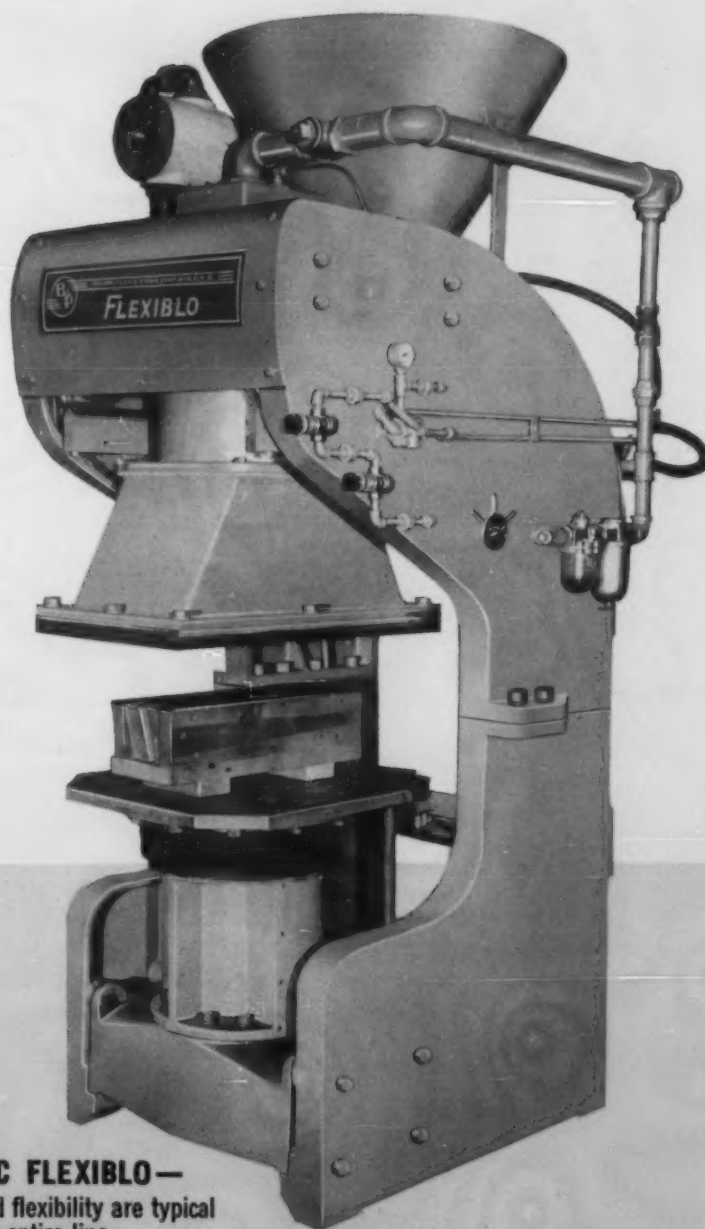
**B&P
PROGRESS
REPORT**

**THE
NEWEST
LINE**

THE WORLD'S FASTEST SELLING COREBLOWERS

7 sizes—to 400 pounds capacity

- Clean, streamlined design
- Cast steel frames for maximum rigidity
- Handles any sand blown by any machine
- Unequaled blow valve design
- Simplest all-pneumatic control
- Fail-proof automatic sequence operation
- Advanced design diaphragm table clamp
- Most accurate air-on-oil draw
- Choice of manual, semi-automatic, or automatic operation
- Minimum core box wear—blow-bys eliminated
- Handles any core box—wood or metal—that can be blown on any machine



THE CB15C FLEXIBLO—
its simplicity and flexibility are typical
of the entire line

**NEW
FOR
'58**

**NOW . . . more than ever before . . . if it can be blown at all,
it can be blown harder, faster, at lower cost, and with less
core box wear on a FLEXIBLO!**



AFS FOUNDRY SHOW

**B&P
PROGRESS
REPORT**

PROGRESS IN SHELL PROCESSING

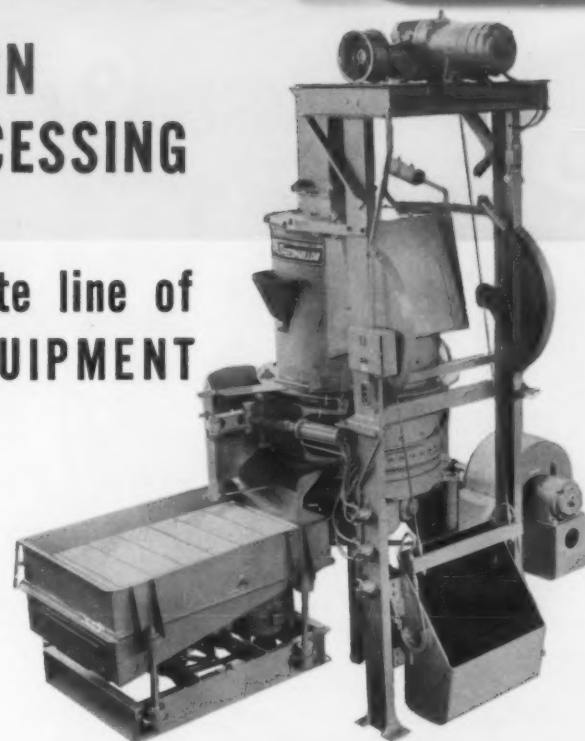
the only complete line of SHELL SAND COATING EQUIPMENT

MODEL HP SPEEDMULLOR... the ONLY muller that resin-coats sand by all processes.

- Hot Process
- Cold Process
- Warm Process
- Novolak Process
- Any Other Process
- Shortest cycle by far
- Highest physical properties

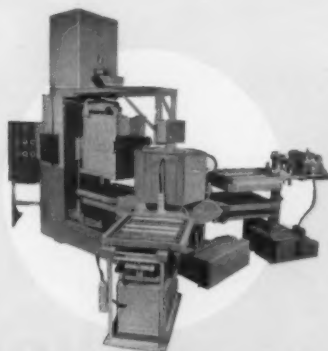
SHELL SAND MULBARO

- Cold process
- Lowest cost—complete processing
- Controlled operation
- Liquid or powdered resin
- Really portable—really compact
- No heaters or auxiliary equipment require
- Highest capacity of any low-cost unit



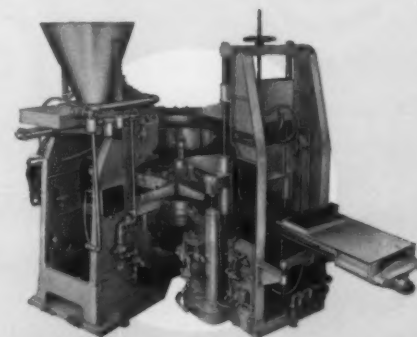
MODEL CP SPEEDMULLOR

- Cold process
- Develops maximum physical properties
- Four times faster than any other muller
- Greatly reduced resin contents
- Most capacity per square foot of floor space
- Most capacity per dollar invested



FORMATIC SHELL MOLD MACHINE

- Maximum productivity with minimum floor space
- Maximum flexibility for every production requirement
- One, two, three or four pattern units
- Automatic operation—every essential factor is precisely controlled
- Enlarge as required—package design

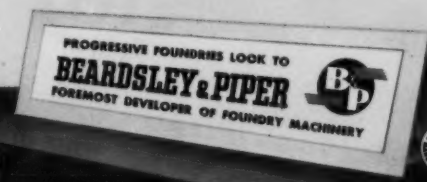


CORMATIC SHELL CORE UNIT

- Highest capacity at lowest man-hour requirement
- All-pneumatic control circuit
- Rotary index or shuttle-type
- Vertically or horizontally-split core boxes
- Solid, mandrel or dump-out type cores
- Automatic precision control

**SEE THE B&P SHELL EXHIBIT
AT THE AFS FOUNDRY SHOW**

Beardsley & Piper, Div. Pettibone Mulliken Corporation, 2424 N. Cicero Ave., Chicago 39, Ill.

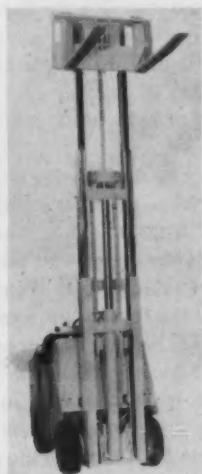


Details on these products and processes are available to MODERN CASTINGS readers. See page 7-8.

mold chamber with specimen, shortening mounting time. *Buehler, Ltd.*

For Manufacturer's Information
Circle No. 822, Page 7-8

TRIPLE LIFT MAST TRUCK . . .
combines high stacking ability with low headroom clearance of 71 in. providing safe entry into rail cars,



highway trailers, and low-ceiling storage areas. Maximum lift is 144 in. Company states that standard masts with 120-in. lift have, by comparison, an over-all lowered height of 83 in. *Towmotor Corp.*

For Manufacturer's Information
Circle No. 823, Page 7-8

MAGNETIC SEPARATION . . . of gagers, core rods, and bits of metal from shakeout sand permitted without exposure of movable parts to materials being separated. Magnetic field created by permanent magnets revolving within stainless steel cylinder. Models available with magnetic field lengths of 6, 18 and 36 in. *Carpco Mfg., Inc.*

For Manufacturer's Information
Circle No. 824, Page 7-8

HYDRAULIC DUMP BUCKET . . . attachment for electric fork trucks scoops and dumps sand, coke, small castings, and other materials; operated from controls in driving compartment. Materials held in scoop by maximum upward tilt of 30 deg; maximum downward tilt is 45 deg, allowing materials to be completely dumped. Attachment functions at any height up to maximum lifting height of the truck. Five or 10-ft capacities;

Circle No. 922, Page 7-8

FLUX

It's
Almost
magic

Famous Cornell Cupola Flux gives you cleaner metal—sulphur is reduced. Castings are of better quality—machine better. Yet, this famous flux costs only a few cents per change of metal. Why not get more details now!

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CUPOLA FLUX
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Circle No. 923, Page 7-8

May 1958 • 19

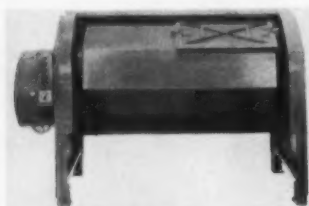
mechanical dumping units also available. **Lewis-Shepard Products, Inc.**
For Manufacturer's Information
Circle No. 825, Page 7-8

FLAP WHEEL POLISHING . . .
and finishing of contoured as well as flat metal surfaces said to give production rates and useful life not previously available in wheels of this type. Hundreds of pieces of coated



abrasive cloth, stiffened to resist pressure, make up this new wheel—sizes 6x1 up to 16x6 in. Wheels marked to show direction of rotation and maximum permissible speed. **Behr-Manning Co., Div., Norton Co.**
For Manufacturer's Information
Circle No. 826, Page 7-8

LEAK-PROOF BARREL FINISHING . . . machines in capacities of 5-25 cu ft feature cylinder sealing method which manufacturer claims assures leak-proof operation under all condi-



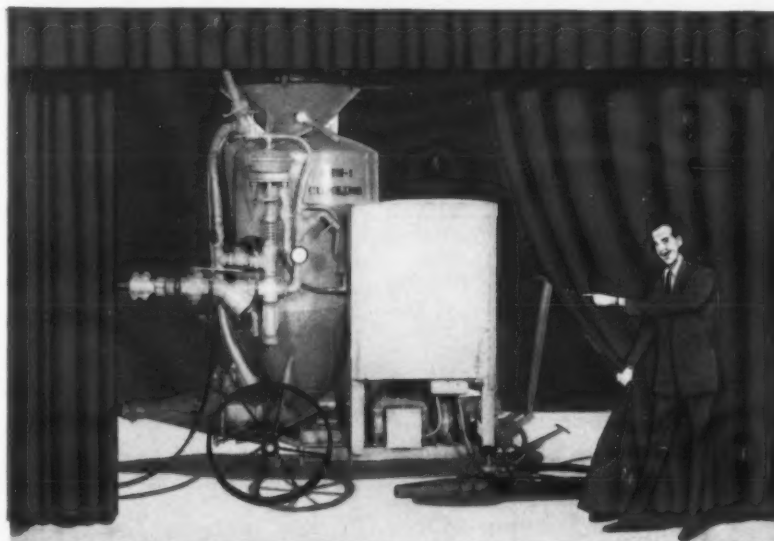
tions. Officials state that by eliminating conventional chain drive, along with other innovations, the machine offers barrel finishing with exceptionally smooth operation. All models have variable speed control, and full opening doors with no ledges to catch media and parts. **Crandall Engineering & Mfg., Inc.**
For Manufacturer's Information
Circle No. 827, Page 7-8

DIE CASTING METAL LUBRICANT . . . and rust preventive which prevents metal to metal contact and stays on metal to insure lubrication where needed. The liquid, which disperses in water to form dilutions, is said to replace oils, grease, graphite, silicones, and white lead; also claimed not to clog spray systems, or have any harmful effect on metal



A SNEAK PREVIEW

Regardless of what you think after studying the illustration, this is not a Sputnik launcher. It is a foundry refractory gun. It just goes to show what happens when we write a memo to the air-placement engineering group as follows:



"Since we introduced the refractory gun principle to the foundry industry nine years ago, we have sold, serviced, and operated over 700 Bondactors and Cupolinors. We think we

know what the foundryman wants; now all you have to do is build it.

"It must be a *one man* machine. We don't mean that he just starts and stops it by himself. We mean that the

man in the cupola must be able to control the rate of feed, the pressure, the moisture, and every phase of the operation with no outside help. It must be as fast as the fastest Cupolinor or as slow as the slowest competitive machine or anything in between, depending on what the customer wants. It must have a smoother flow than any machine ever built for the purpose.

"It must be designed to be built in a wide range of sizes, probably as small as 1000 pound capacity and maybe as large as 6000 pound capacity (or even bigger). It should be such that the foundryman can hook it directly to his permanent patching material-hopper, if he wishes to eliminate all manpower in filling and handling the materials except for the one individual in the cupola. It must be cheap enough to be able to pay for itself easily and quickly out of the savings in labor alone (as compared with the two-man machine). And it must be ready to show in Cleveland in May of 1958."

To make a long story short, they did it. We got it. The first one of our men to operate this machine in the field came back with such enthusiasm that the entire engineering staff de-

WHAT DOES YOUR CUSTOMER WANT?



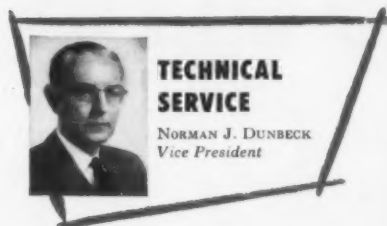
One of the subjects discussed last year at a New England Foundry Convention was a survey made by the gray iron foundry society which got replies from more than 700 purchasing agents and 1500 design engineers. This survey indicated that of the foundry customers (your customers), 66% were interested primarily in quality, only 18% in price, and 16% in delivery or service. They want the best price only after the survey clearly showed that they are assured of quality.

The development of such things as the **Taccone Molding Machine**, **Plasti-Bond sand additives**, and **Dixie Bond** and other products is directly related to the desire to improve the quality of castings.

In addition to using such things as **Plasti-Bond** to improve quality to appeal to at least 66% of the market, some foundrymen have also featured these products in their own advertising and selling campaigns. A number of the Taccone foundries, for example, are

advertising and selling the fact that the Taccone Machine and Plasti-Bond assure their customers a better product. Your customer is interested in the fact that you are doing something definite about maintaining your quality. If you are interested in reaching that 66% of the market which wants a better casting, we will be happy to show you what our "special" products can do to make your selling easier.

manded an increase in salaries. After discounting half of what he said on general principles, it still looks like we may have what our customers have been requesting for over five years. We will continue to field test it between now and convention time and then we will be very much interested in your reactions when you see it in our booth at the show.



You who know Norman J. Dunbeck, as so many of you do, will not be surprised when we introduce him, our Vice President, as a member of our Technical Service Staff. For, you see, it is Norm Dunbeck's philosophy of wanting to provide sound technical service to the foundry industry that has inspired the entire Eastern Clay organization.

Norman Dunbeck's interest in technical service stems from nearly 40 years of foundry work. Two years after graduating from college with a B.S. Degree in Chemical Engineering, he joined Eastern Clay. He became Plant Superintendent in 1927 and Vice President in 1936. When IMC acquired Eastern Clay in 1951, he became Vice President of the parent organization.

Mr. Dunbeck is one of the foundry's outstanding personalities... author, lecturer, and pioneer in the development of many basic improvements in foundry sand practice. He is a member of A. F. S., A. C. S. and A. I. M. E. and has contributed generously of his time and effort to activities of the Societies.



EASTERN CLAY PRODUCTS DEPT. INTERNATIONAL MINERALS & CHEMICAL CORPORATION

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Circle No. 924, Page 7-8

SUPER HOT STRENGTH AND DRY STRENGTH

When we first brought out Balanced Revivo many years ago, someone said, "Oh, you finally admit that Revivo isn't balanced." We explained quickly that Balanced Revivo is not one clay but a special blend of five ingredients. In combination with other clays, it can give you: (1) high green strength with very high dry strength, (2) very high green strength with high dry strength, (3) very high green strength with moderate dry strength, (4) very high green strength with low dry strength, (5) moderate green strength with very high dry strength, (6) moderate green strength with moderate dry strength.

This is impossible, of course, if we are talking about one material. Actually, the proper combination of Balanced Revivo with Revivo or Dixie, or Black Hills bentonite gives almost any properties you want. The primary function of Balanced Revivo is to provide hot strength properties. Its green strength is adequate. Its dry strength and hot strength are maximum. Alone, it is a complete and adequate binder for heavy work or for dry sand molding.

Although Balanced Revivo is particularly designed for skin dried or dry sand work

and to stop washing and scabbing in green sand molding, it is also widely used as an additive for naturally bonded sands such as Albany in producing brass and bronze castings. We would not normally think of bronze as requiring a high hot strength but the characteristics of Balanced Revivo seem to be the perfect augment for the natural sand used in the non-ferrous industry!

Balanced Revivo is not a cheap binder since it is sold in the range of \$50.00 per ton. However, it is widely used by foundries to produce green sand and skin dried work from the same sand. It is excellent for large dry sand work as it combines both high green strength and high dry strength with the ability to skin dry or bake. Many foundries use it to produce loam castings, swept molds, skin dried molds, and green sand molds all with the same base sand, using Balanced Revivo as a principal bond. A brochure on Balanced Revivo would help you decide if it is of interest to you. Or better yet, talk with us. IMC is in the unique position of producing all available types of sand binders or bonding materials so we are completely impartial when recommending the best sand practice.

He has worked on problems of synthetic sands and binders since 1923 and also directed the research and successful adaptation to foundry practice of Southern bentonite, chemically coated sands and air

placement of cupola refractories.

Norman Dunbeck's leadership is reflected in the technical competence and spirit of helpfulness of the Eastern Clay representative who serves you in your foundry.

■ Details on these products and processes are available to MODERN CASTINGS readers. See page 7-8.

or operating personnel. Remains on surfaces up to 3000 F, and may be easily removed with water, alkali solutions or solvents. *Harry Miller Corp.*

For Manufacturer's Information
Circle No. 828, Page 7-8

ULTRASONIC INSPECTION . . . non-destructive testing unit useful in determining safe operating condition of machinery without disassembly. In-



strument is said to be used in maintenance operations as well as in quality control, safety promotion and materials analysis. *Sperry Products, Inc.*

For Manufacturer's Information
Circle No. 829, Page 7-8

DUMPING HOPPER . . . automatically dumps scrap, sand, castings, etc. by releasing lever. Platforms may be specified for fork lift trucks, or unit may be mounted on casters for in-plant use. Returns to upright position after dumping. Said to dump well over edge of container, assuring a balanced load. Capacities 1/2 to 3 cu yds. *Borg-Warner Corp.*

For Manufacturer's Information
Circle No. 830, Page 7-8

DIELECTRIC SAND CORE OVEN . . . claimed by manufacturer to cut baking time from hours to minutes. Unit includes oscillator, oven, conveyor and control panel furnished as standard equipment. Adjustable electrode control is said to compensate for physical variances in cores, eliminating burning and incomplete baking. Storage space is reduced because cores require no cooling time; manufacturer states they can be used immediately. The oven needs no pre-heating and is ready for use in seconds. *Allis-Chalmers Mfg. Co.*

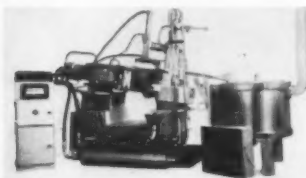
For Manufacturer's Information
Circle No. 831, Page 7-8

HIGH HEAT CYLINDERS . . . standard air and hydraulic, permit continuous elevated temperature operation in applications involving heat treating,

drying and annealing ovens, furnaces and die casting where heat formerly prohibited use of hydraulic or pneumatic power. Use of high temperature packing and silicone greases permit efficient operation at -20°F as well as in extended ranges. *Carter Controls, Inc.*

For Manufacturer's Information
Circle No. 832, Page 7-8

AUTOMATIC DIE CASTING . . . machine produces zinc alloy castings up to 1 lb at production rates claimed to often exceed 1500 shots per hour. Fully automatic operations include machine cycling, die cleaning and



lubricating, inspection for foreign matter in the die, water control, replenishing molten metal supplied to machine and picking off of castings. *DCMT Sales Corp., Div. of British Industries Corp.*

For Manufacturer's Information
Circle No. 833, Page 7-8

OVERLOADING SWITCH . . . eliminates overloading of cranes or hoists by automatically cutting off power to the motor when overloading occurs. Reverse switch will return load to the floor; excess must be removed before load may be lifted. Unit features



lifting hook at the bottom which is said to accommodate almost any hoist or crane; and can be set to operate between 500-10,000 lb. Switch also can be used to ring bells or operate warning lights. *W. C. Dillon & Co.*

For Manufacturer's Information
Circle No. 834, Page 7-8

with the *Exclusive* *fine* **FANNER FAN-S-CHILLS** provide superior chilling and greater savings

A triumph of modern research and engineering—the FAN-S-CHILL, through its curved "S" design, provides 75% more chilling surface since there is no solid mass.

Exclusive design with its perforated surface and double channel permits maximum parent metal fill-in . . . fuses into cast metal solidly, completely . . . assures better quality castings.

Formed steel fabrication provides highest possible chilling efficiency . . . ideal for general chilling purposes . . . especially in steel.

Lightweight construction provides triple savings—in cost, in shipping and in handling.

Get the facts on the many cost saving features of the fine FANNER FAN-S-CHILL . . . write today for samples and latest prices.

SPECIFICATIONS:

WIDTH: $\frac{3}{8}$ " — $\frac{1}{2}$ " — $\frac{3}{4}$ " — 1" — $1\frac{1}{4}$ "

LENGTH: $\frac{1}{2}$ " to 5"

Made in heavy, medium and light gauges.

Copper, aluminum or tin coated.

Lighter or heavier FAN-S-CHILLS in special sizes can be made on request.

ENGINEERING SERVICE:

Qualified and specialized engineers in Fanner's Technical Service Division are available for consultation, without obligation, on problems of producing more intricate castings; developing increased strength, closer tolerances, and better quality; reducing machining and improving finish—both in ferrous and non-ferrous castings. Take advantage of the research and development work that Fanner has invested in this field to improve your profit picture! Simply direct your request to the address shown below.

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May 19th-23rd, 1958
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THE FANNER MANUFACTURING CO.
Designers and Manufacturers of FINE FANNER CHAPLETS AND CHILLS
BROOKSIDE PARK CLEVELAND 9, OHIO

CURVED "S" DESIGN



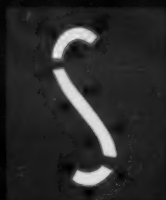
LIGHTWEIGHT

Savings in cost. Lower shipping charges. Easier to handle on the job.



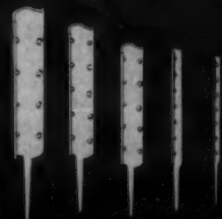
GREATER FUSION

No pockets to trap gases. Perforations permit metal flow-through. So completely fused, difficult to detect even with X-ray.



GREATER CHILLING SURFACE

75% greater chilling area since there is no solid mass — produces better castings.



5 STANDARD SIZES

The ideal chill for a wide range of applications. A size for every need — eliminates makeshift chilling.

Future Labor Shortage to Pose Problems for Industry

by G. C. Cook
General Electric Co.
Schenectady, N. Y.

■ How far do you plan ahead in your business operations? Do you operate on a day-to-day basis? Do you plan ahead a month, a quarter, a year, ten or twenty years? Most businesses recognize the value of yearly budgets concerning sales, production levels, costs and expenses; not so common are plans reaching out five, ten or more years into the future. Yet, major investments, hiring of key people, and authorization of major developments are done with an eye to sales we hope to make five to twenty years hence. We need to look into the future as accurately as possible.

Factors Responsible

Economist Peter Drucker points out in his, *America's Next Twenty Years*, that ten years from now we can expect a labor shortage. In the 1920's and 1930's, birth rates were low, increasing sharply in the 1940's and 1950's. Also, people are living longer because of better food, medicine and care; hence, in 1967 there will be far more non-workers under 18 and over 65, proportionately, only a few more workers. We can estimate that our country will need 40 per cent more goods, with only 14 per cent more workers to produce them.

Plan Now

It may seem far-fetched today to worry about a labor shortage several years from now, but we need to start now to plan for the future when the foundry industry will be competing with other industries for workers. Labor saving machinery must be developed, and we must plan to eliminate the hottest and dirtiest jobs which will be hard to fill. All our jobs must be made more attractive for the prospective worker. Foundrymen who remember the headaches of short periods of labor shortage in the past will recognize how vital it is to begin now to prepare for a labor shortage with an expected duration of several years.

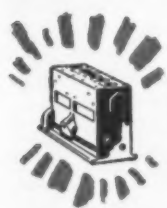
The competitive future of our products, readiness to serve expanded markets require long range plans. Attending to the staggering work load and finding time for longer cycle planning can prove unmanageable unless we learn to better budget our time. This is the most difficult of all managing jobs and by far the most important.

■ Condensed from a talk delivered before the 1957 New England Regional Foundry Conference.

NARCOLINE

Slag-Resistant Plastic Refractory

NARCOLINE



NARCOLINE Assures Cleaner Castings

It successfully resists the erosive and corrosive action of metals and slags, eliminating refractory inclusions from the casting.

NARCOLINE Facilitates Metal Flow

It resists graphite burn-out under operating conditions, and maintains a lasting lubricated surface for easy metal flow.



NARCOLINE Assures Easy Slag Removal

It resists the wetting action of molten metal and slag, permitting ladles to be cleaned of solidified metal and slag with little effort.

NARCOLINE Easy to Install

It can be rammed to any desired shape with mallet or air hammer. Requires no special training to install.



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Circle No. 926, Page 7-8

the editor's field report

by

Jack Schaum

■ Thanks to Cooper Alloy Corp., Hillside, N. J., Crane Co., Chicago, and Sandusky Foundry & Machine Co., Sandusky, Ohio, the metalcasting industry did not go unrepresented at the Atomfair in Chicago. These three progressive foundries exhibited their abilities to provide vital cast products for atomic power plants. Cooper and Crane supply cast stainless steel valves and fittings while Sandusky centrifugally casts stainless steel pump stator shells. These valves and pumps are handling radioactive water at 670 F, 2500 psi in nuclear power systems. According to the Atomic Industrial Forum by 1960 over 25 million dollars of nuclear plant valves and fittings will be needed and by 1963 the annual demand should rise to 90 million dollars. A feature story on the Sandusky Foundry operation will appear in Modern Castings soon.

■ We knew it all the time but now it's official. A recent study by the Federal government indicated that the assistance of material and equipment suppliers is second only to in-plant experiments and tests in solving the small manufacturer's problems in processes and equipment, new product development, quality control, product maintenance, raw materials, finished components and product improvement. The importance and extent of this fact is brought out in the program of the 62d Castings Congress. Out of almost 100 technical papers being presented, 22 are the results of research conducted or sponsored by companies selling to the metalcasting industry. Today's salesmen are usually engineers with enough product know-how to show the foundryman how to use his product to make good castings at a profit. The technical engineer is often relied on by the foundry to serve as a free consultant to solve many problems only remotely related to the product being sold. So don't underestimate the power and importance of the salesmen, their products, and their company.

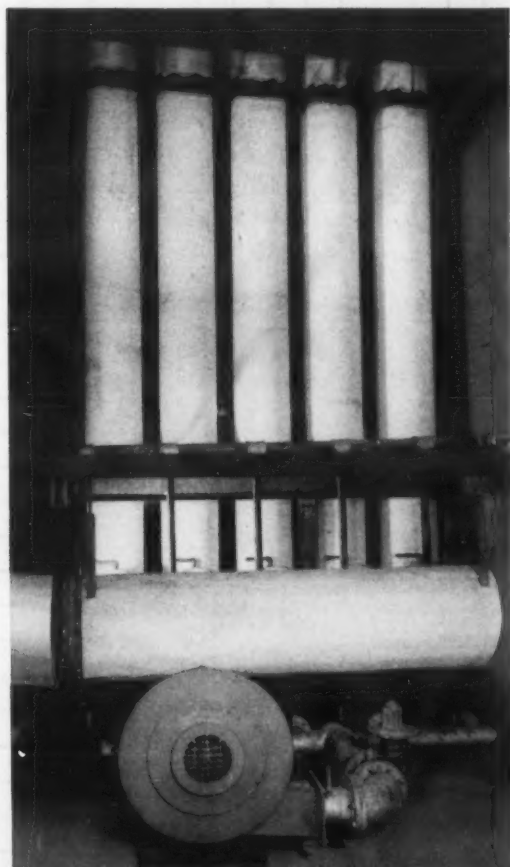
■ Aircraft and missiles need castings that will meet their rigorous demands. The metalcasting industry needs to prove that it can-do. When an irresistible force meets an immovable object the only solution seems to be "to organize". And so the Aircraft Casting Association has recently come into existence. According to Donald A. Slichter, public relations director of the new association, they are dedicated to "promote and develop an extended interest, acceptance and use of ferrous castings manufactured from non-expendable patterns by companies manufacturing aircraft, missiles and related products." Organized action such as this should help arouse to its full potential our sleeping giant—the foundry industry. More details about the A.C.A. are in this issue.

■ Observations of advanced foundry techniques in 84 foundries located in nine European countries will be disclosed by Clyde Sanders, vice president, American Colloid Co., in a feature Modern Castings story next month. Don't miss reading about the amazing metallurgical practices that are in your foundry future. Learn how molten iron and steel are being made directly from iron ore! How metal is melted as it floats in space without contacting a crucible! How one man sits at a control panel and assembles molding sand raw materials, mixes them and delivers mix to work stations!

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HOT BLAST AIR FOR YOUR CUPOLA

500° TO 1200°



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Foundry Company
Grafton, Ohio



Cuts Cupola Coke Consumption Up to 30%

"Hot Blast" air preheaters offer dramatic new advantages to the foundry field.

1. Up to 30% coke savings
2. Better control of hot metal temperature
3. Silicon oxidation losses reduced
4. Improved sulphur control
5. More rapid heating
6. Increased metal production
7. Hotter iron at the mold
8. Production of better castings
9. Metal charge can be of lower quality

Get the Facts -

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1662

AT AFS CONGRESS

THE BROWN THERMAL DEVELOPMENT CO.

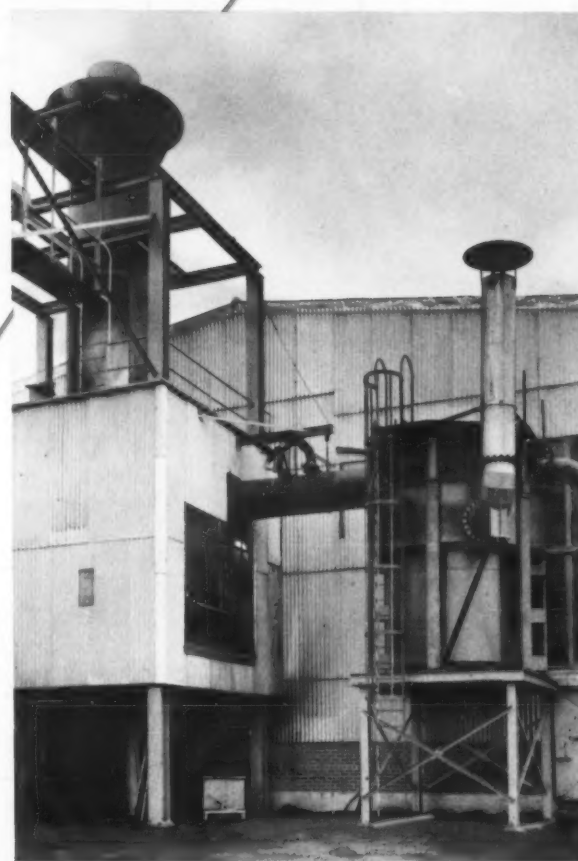
Subsidiary of Brown Fintube Company
Elyria, Ohio

BROWN Thermal Preheaters **HOT** **BLAST AIR**

At 1200° F. for

James B. Clow & Sons

Coshocton, Ohio



In November, 1957, the Brown Thermal Development Company installed a 6,000 cubic foot Hot Blast Preheater at the James B. Clow & Sons Plant, Coshocton, Ohio. This unit is now furnishing hot blast air up to 1200° F. Units like this offer foundries the following advantages:

- ▶ A return of up to 30% in coke savings a year is possible.
- ▶ Use of Brown's Fintubing application, to increase surface area, which reduces physical size of preheaters and assures higher efficiency.
- ▶ Unique counter-flow principle to obtain ultimate in thermal efficiency.
- ▶ A completely packaged unit including burners, controls and safety devices.
- ▶ Fully automatic for ease of operation.
- ▶ Completely instrumentated for accurate temperature control.
- ▶ Large capacity (6,000 to 15,000 cfm up to 1200° F.)
- ▶ Backed by 20 years of heat transfer engineering.



YOURS FOR THE ASKING
Learn how Brown Thermal Hot Blast Heaters can slash coke costs and produce better castings. Write for complimentary copy of Bulletin No. 586.

BROWN THERMAL PREHEATERS

THE BROWN THERMAL DEVELOPMENT CO.

Subsidiary of Brown Fintube Company

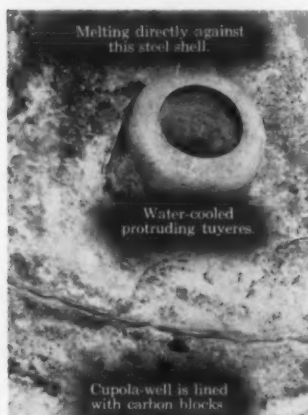
Elyria, Ohio

Foundry Show

PRODUCT REVIEW

■ The following items are products of companies exhibiting at the Foundry Show in Cleveland. Modern Castings received literature describing these products at a date too late for their inclusion in "Preview of Tools and Techniques," April Modern Castings.

CAST-COPPER TUYERES . . . for water-cooled cupolas are claimed to reduce tuyere area as the tuyeres relate to the overall cross-sectional area of the melting zone. They are set away from the carbon blocks or carbon paste to reduce maintenance costs; this is said to create a greater



back pressure within the wind drum, insuring equal air distribution through individual tuyeres, deeper penetration and good gas to solid contact. A live, direct telecast from a Cleveland foundry will demonstrate benefits of this tuyere development in booth No. 1662-1664, 1721-1723. *Modern Equipment Co.*

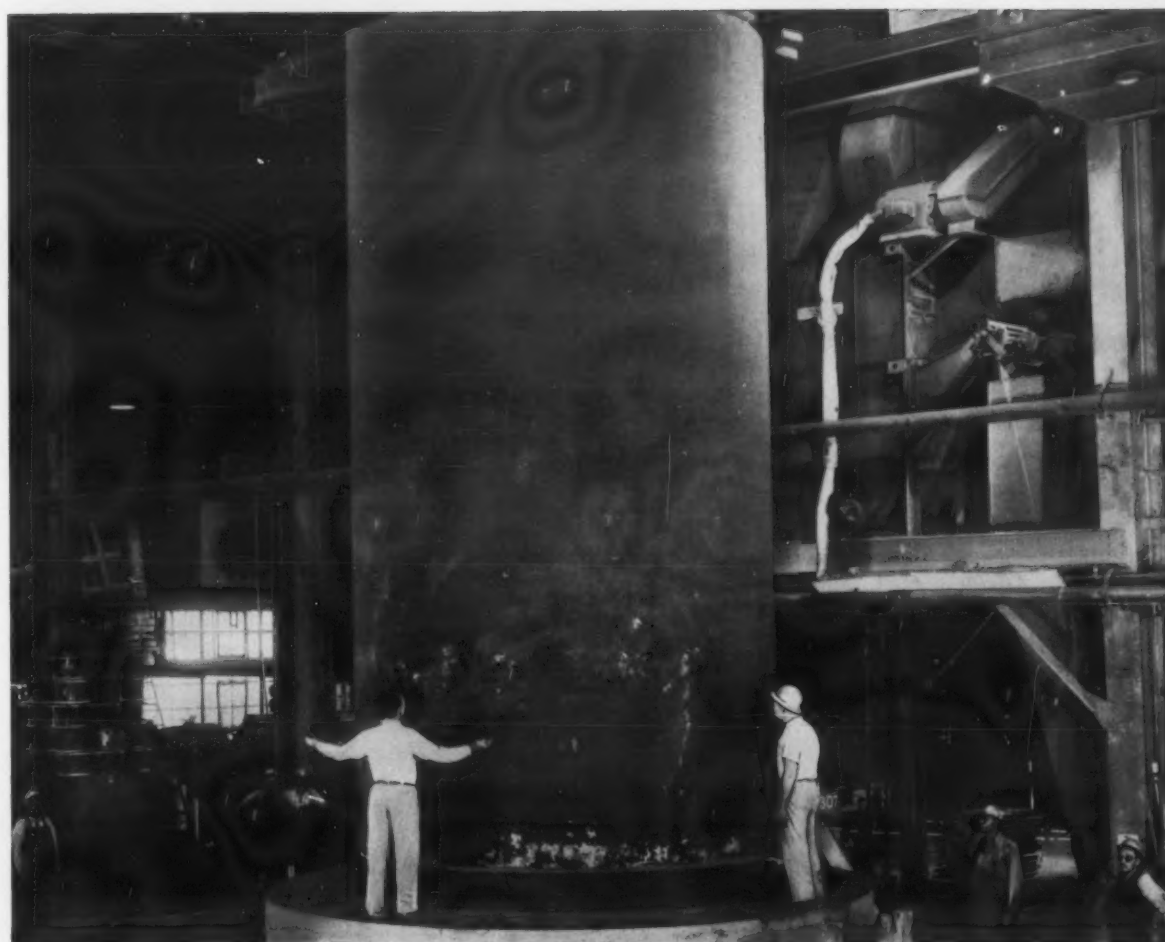
For Manufacturer's Information
Circle No. 840, Page 7-8

CORE BINDER . . . pitch for use as sand binder is made under controlled conditions to assure bond of uniform density and strength. Manufacturer reports Nu-Bond Pitch is result of three-year study of mechanics of bonding sand grains. Pitch is recommended binder for large cores and use with burned or clay-bearing sands. More information may be obtained at booth No. 1318. *Penn-Rillton Co.*

For Manufacturer's Information
Circle No. 841, Page 7-8

PORTABLE PNEUMATIC CONVEYOR . . . said to save materials han-

Circle No. 927, Page 7-8



40-Ton Dryer Roll being removed from the mold at Newport News Shipbuilding and Dry Dock Company, Newport News, Virginia.

How nickel cast iron helps take the risk out of large castings

Here's a Yankee dryer roll for example. It weighs 40 tons. Length: 262 inches. Diameter: 12 feet.

It's just too big to take a chance. The foundry can't afford a reject. Especially when a reliable metal can assure pressure tightness... ample strength... a smooth surface... and easy machining.

Nickel cast iron assures a sound casting through uniform metal structure

Nickel irons combine fine graphite in a uniform matrix. They promote strength and rigidity, and a surface free of imperfections.

Because of these properties Newport News specifies a nickel cast iron for these rolls. Even with today's high steam pressure this nickel cast iron dryer roll will stay pressure tight. It's definitely not a leaker. Its surface, thanks to nickel cast iron, is uniform and smooth.

The roll easily meets the strength levels required by

the boiler code. The basic 1.34% nickel iron composition achieves 40,000 minimum tensile strength every time.

And Newport News needs nickel cast iron to get the high polish, mirror-like finish required on the roll. Uniform structure and the absence of carbides and defects afford a readily machined and polished roll.

You, too, can get this dependability in heavy iron castings — or in light ones that need high strength, pressure tightness and good machinability. Nickel cast irons are quality castings. And quality castings are good business... for you, and for your customer.

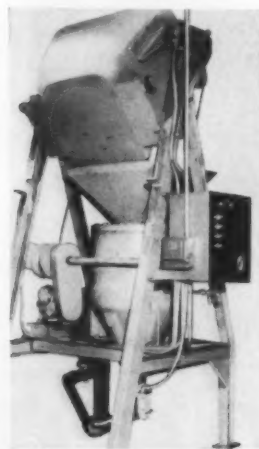
For assistance on specific composition problems, contact Inco. Our engineers will gladly provide the metallurgical information you want.

THE INTERNATIONAL NICKEL COMPANY, INC.
67 Wall Street
New York 5, N. Y.



NICKEL CAST IRONS

dling time, moving bonded core sands from muller to work stations in 13 sec. Conveyor successfully conveys molding sands, bonded core sands, resin coated shell sands, dried silica sand, hot sand from shakeout and other foundry materials. Manufacturer claims shake out sands are cooled in



the process of delivery, and molding and core sands are delivered properly aerated, with moisture impregnation equivalent to 24 hr tempering time. Whirl-Air-Flow conveyors offered in three sizes, need no pit beneath the transporter, and require little headroom. An operating pneumatic conveyor system will be included in the company's exhibit in booth No. 1648-1747. *Whirl-Air-Flow Corp.*

For Manufacturer's Information
Circle No. 842, Page 7-8

CHAIN FEED CORE BOX . . . and fillet machines which make elbow, straight, and other irregular shaped wood core boxes will be demonstrated at the Foundry Show, booth No. 118-A. In addition to making 11/16



to 16 in. diameter core boxes, these machines will fabricate 11/32 to 8-in. straight or circular wood fillets.

Circle No. 928, Page 7-8



**Today's most
and competitive
big and small...**

How to hold the edge on competition . . .

Let's agree on this basic point: *the real target for any foundryman today is production at lowest possible cost.* A strong, low-cost foundry operation means you're in an excellent competitive position—for extra business . . . for added profit.

How do you build that "strong, low-cost operation?" At Osborn—we believe it works like this . . .

Low costs *do not* automatically or magically result from production equipment alone. There's a *balance* that must be set up between equipment and other operating factors in your foundry—*manpower . . . maintenance . . . scrap . . . floor space and traffic flow.*

Only when these operating factors *plus* efficient production equipment are in *balance* can you begin to cut costs and *operate competitively.* Osborn has that kind of know-how—over 50 years of application experience to help you hold the edge on competition.

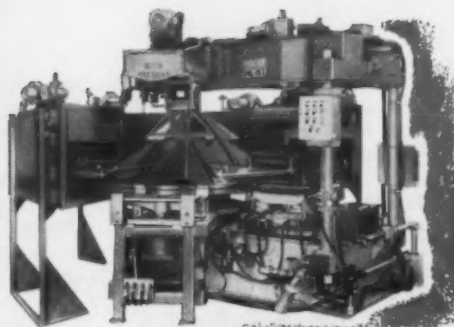
Get details at the AFS Foundry Show . . . where a complete staff of Osborn foundry engineers will discuss and demonstrate advanced techniques—and display a cross-section of Osborn's famous line of production machinery. *The Osborn Manufacturing Company, 5401 Hamilton Avenue, Cleveland 14, Ohio.*



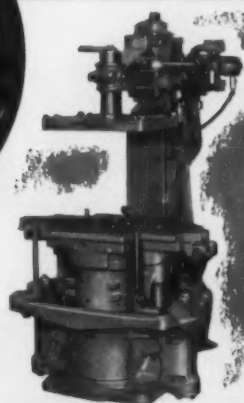
**advanced equipment
methods for foundries
are by OSBORN**

Move ahead
with

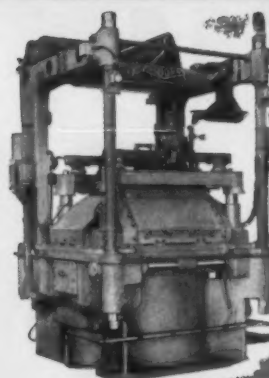
OSBORN
at the
**AFS FOUNDRY
SHOW**



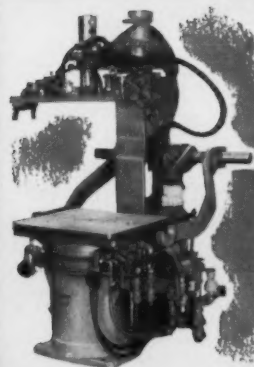
SHEL-DEX®
Shell Production Machine
®Trademark



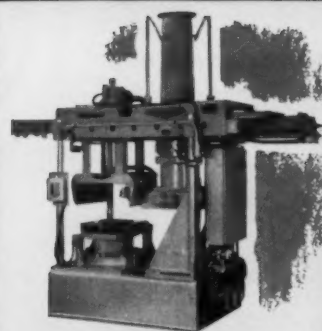
VIBRATING-SQUEEZE-STRIP
No. 714 PVA Molding Machine



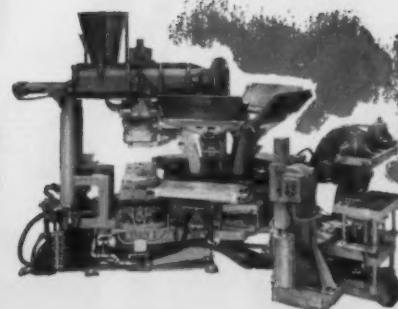
JOLT-SQUEEZE-STRIP
No. 1236 Molding Machine



ROTA-LIFT®
Match-Plate Molding Machine



BLOW-SQUEEZE-STRIP
Molding Machine



ROTO-CORE®
Automatic Core Production Unit

■ Details on these products and processes are available to MODERN CASTINGS readers. See page 7-8.

Three models of this machine, claimed to require a maximum of 10 min set-up time, will be displayed. Hand wheel chain allows operator to stand away from cutters, and is said to give easy control of feed from front of machine. *Glover Mfg. Co.*

For Manufacturer's Information
Circle No. 843, Page 7-8

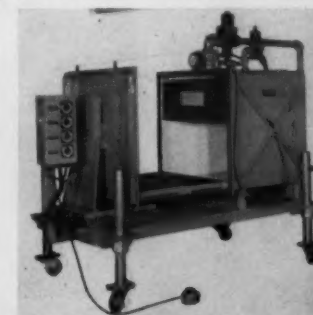
ALUMINUM DEGASSER . . . tablet is said to result in more efficient degassing when plunged deep into a melt. Vigorous bubbling subsides gradually to react over lengthy period, manufacturer claims. The Fosco Degasser 400 tablets are said to con-



siderably curtail fuming and to eliminate the risk of inclusions. A plunger rod is inserted through the hole in the center of the tablet, dispensing with bell-shaped plunger and its reported shortcomings. Aluminum will be melted in booth No. 2102-2206 to demonstrate this and other products of Foundry Services, Inc.

For Manufacturer's Information
Circle No. 844, Page 7-8

CO₂ VACUUM CHAMBER . . . gassing machine said to provide cores with approximately double the as-gassed strength and 40 per cent great-



er shelf strength than straight pressure gassing, while greatly reducing

Circle No. 928, Page 7-8



... leader in mechanization for the foundry

THE OSBORN MANUFACTURING COMPANY

5401 Hamilton Avenue, Cleveland 14, Ohio

MOLDING MACHINES • CORE BLOWERS • SHELL MOLDING MACHINES • BRUSHING MACHINES • INDUSTRIAL BRUSHES

May 1958 • 29

susceptibility to moisture deterioration. Manufacturer claims CO₂ consumption of Alphaco Gasser one-third less than in ordinary machines. Gassing done in box on driers or plates; machine cycles to 10 sec, chamber capacities to 1000 cu ft. This machine will be on display in booth No. 324. *Alphaco, Inc.*

For Manufacturer's Information
Circle No. 845, Page 7-8

SEMI-VOLATILE PARTING . . .
is stated to release sand from pat-

terns or core boxes at either elevated or room temperatures. When light film of Delta Part-Rite is sprayed over pattern or core box, "polar release molecules" allow core or molding sands to pack over surface without surface abrasion or sand friction, eliminating sticking, and said to result in smooth, clean mold and core surfaces with better dimensional tolerances and pattern details. Also useful as anti-corrosion material on surfaces of stored core boxes and patterns. Visit booth

No. 605 for information. *Delta Oil Products Co.*

For Manufacturer's Information
Circle No. 846, Page 7-8

NEW TRACTOR SHOVEL . . . being introduced at the Castings Congress, Cleveland, for the first time, claimed to have 25 per cent greater work capacity than units previously available. The Y-18 tractor shovel features 2500 lb carrying capacity, dumping clearance of full 6 ft, automatic transmission, rapid acceleration, and a top



speed of 13 mph. Bucket tip-back of 45 degrees said to offer best loading action and low-level carrying posi-

HINES

HI-FLEX *

CAST

JACKETS

*another
new HINES advancement in molding
equipment for better, more economical
foundry production*

tion. Capacities, 10-27 cu ft. Latest materials handling equipment will be demonstrated in booths 1728-1738; 1827-1839. **Yale & Towne Mfg. Co.**

For Manufacturer's Information
Circle No. 847, Page 7-8

NON-FERROUS TILTING FURNACE . . . interchangeable for oil or gas fuel, features new cover-ventilating top construction which manufacturer claims assures easier access to entire bath and accommodates latest bowl-type crucibles. Swing top



design said to compensate for top covers of various thickness and diam-

eter. Precision machined C-H furnace also available in stationary models. Visit the exhibit in booth No. 1658. **Campbell-Hausfeld Co.**

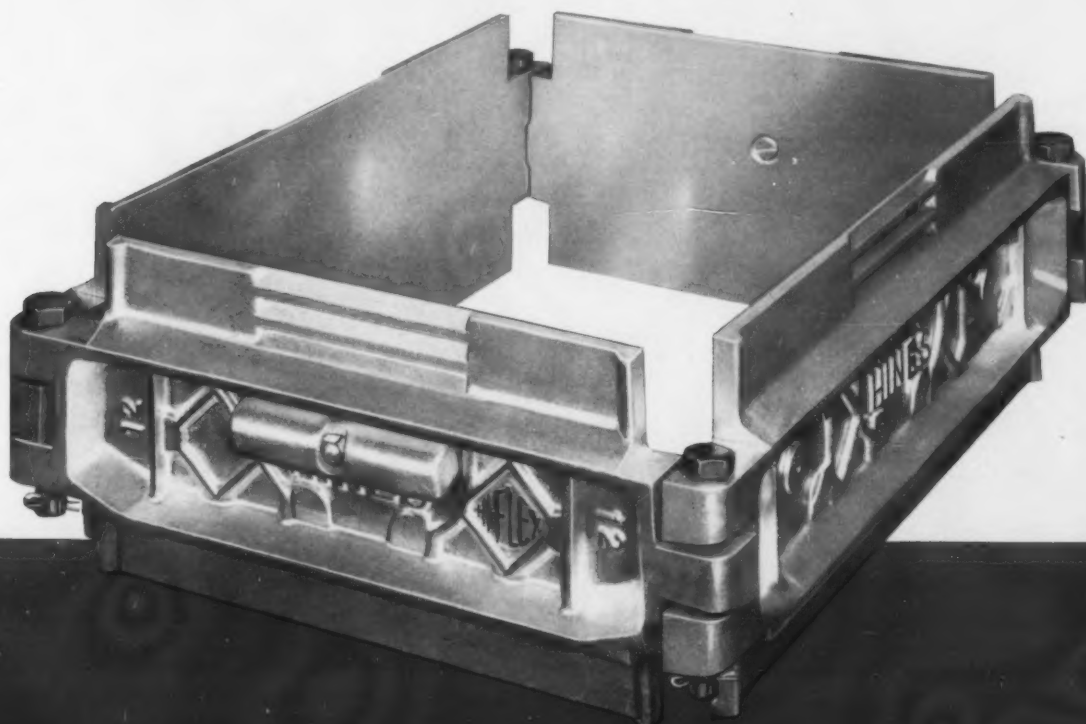
For Manufacturer's Information
Circle No. 848, Page 7-8

CRUCIBLE ALUMINA LINING . . . claimed to extend life of carbon bonded silicon carbide crucibles. The new lining of special high alumina grog, or particles, with a recommended porosity of 5-25 per cent, contains 90 per cent alumina, said to improve

bonding and glaze adherence. Corrosion resistant linings are useful in non-ferrous melting where fluxes are applied. Learn more about this new lining material in booth No. 718. **Electro Refractories & Abrasives Corp.**

For Manufacturer's Information
Circle No. 849, Page 7-8

PORTABLE MOLD DRYER . . . provides a large volume of air at variable temperatures, circulating under high pressure through the mold cavity; claimed to dry all mold sur-



Now, from HINES, comes a truly flexible, cast jacket — the Hi-FLEX®.

This remarkable new jacket, upon application to the mold, instantly and accurately assumes the exact shape of the mold and automatically adjusts itself to the mold taper.

In addition, the fit on the mold, in relationship to the parting line, can easily be changed by replacing the corner pins with pins of

larger or smaller diameter. This feature also permits adjusting the Hi-FLEX® jacket to fit either slip or POP-OFF molds.

Hi-FLEX® jackets are cast of aluminum and iron, in all sizes. They are jig and fixture built to insure maximum accuracy (as are all HINES flasks and jackets). End and side castings may be purchased separately and corner pins are available in a variety of diameters, for changing the fit on the mold. Additional optional equipment — fluted corner inserts and steel corner protection shields.

SEE THE HI-FLEX® AT THE FOUNDRY SHOW . . . BOOTH 606

The **HINES FLASK** *Co.*

3433 WEST 140th STREET • CLEVELAND 11, OHIO



THERE ARE SCORES OF VANCORAM ALLOYS. They come in drums, pallet boxes, container cars, and in bulk. When quantity justifies, most VCA products are available in barge shipments. But no matter which ones you use . . . or the form in which you use them . . . they always contain two basic and unvarying ingredients:

Uniformity, and a high level of quality you can count on. We know this because we control the quality from mine to finished product. We apply over fifty years of alloy-making experience to the task of delivering to you the products that will do your job best, at lowest cost. Furthermore, we back every Vancoram product with a brand of service that matches the high quality of that product.

Vancoram — the first name in alloys, the last word in quality! Next time you need alloys, or help in solving ferro alloy problems, be sure to call your nearest VCA Office or distributor. Remember: they are there to serve you! Vanadium Corporation of America, 420 Lexington Avenue, New York 17, N. Y.

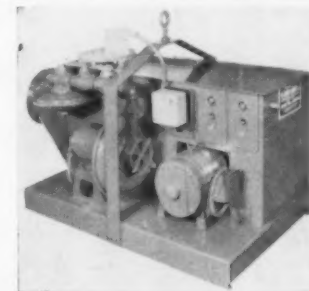
Vancoram Products for the Iron Foundry are also distributed by:
PACIFIC METALS CO., LTD. • STEEL SALES CORPORATION
J. M. TULL METAL & SUPPLY CO., INC.
WHITEHEAD METAL PRODUCTS COMPANY, INC.
WILLIAMS & COMPANY, INC.



**VANADIUM
CORPORATION
OF AMERICA**

Circle No. 930, Page 7-8

faces quickly and uniformly. Company reports that the Coleman FA-600 Portable Mold Dryer, which combines compact design and light weight portability with high drying capacity,



needs only to be connected to fuel and electric facilities for operation. The dryer will be demonstrated at the Foundry Show in booth No. 2019-2021. Foundry Equipment Co.

For Manufacturer's Information
Circle No. 850, Page 7-8

HOLLOW SHELL CORE BLOWER

. . . designed to give operator control over blow time required to fill each mold of two-station machine. The Series 300-H machine features two valves, one to operate lift table to seal the box to the sand carrier and



close self-feeder; the other to operate the blow head. Capacity, core boxes up to 4x10x15 in.; output of finished cores, 60 per hour on each side.

Said to eliminate need for core ovens, driers, plates, core racks, reinforcing wire, and handling time. See company's exhibit at booth No. 2243. Harrison Machine Co.

For Manufacturer's Information
Circle No. 851, Page 7-8

METAL CUTTING, ANY THICKNESS . . . by new Oxweld ACL-3 Powder Lance tool using mixture of oxygen and metallic powder said to pierce materials previously difficult or impossible to cut, with comparative ease and speed. Foundry applications such as opening slag pockets, clean-

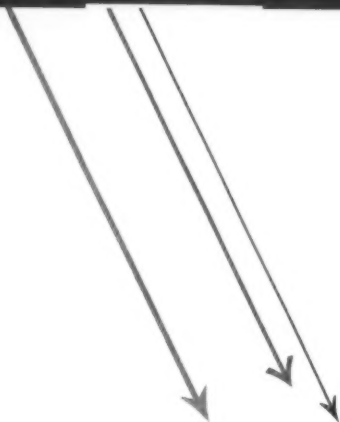
Circle No. 931, Page 7-8

THIS IS
NATIONAL

Engineering



TRANSLATING YOUR NEED FOR PROFIT...INTO PROFIT



The Control of Sand Properties . . .

Your Greatest Source for Profit

The preparation and handling of sand and the control of sand properties can be a principle source of *profit* or a great contributor to the *loss* of profit for *any* foundry.

In today's tight and competitive market, many operators who have an acknowledged need for more carefully controlled sand practices may be *already paying* for the mechanized efficiency they hope to achieve or "afford" . . . at a later date.

This bulletin is designed to point out facts about National equipment and services which can make it easier and more economical for you to consider planned mechanization right *now*—than to "wait for '59" . . . and perhaps miss the *profit opportunities* that will go out of your shipping room door *every day* in 1958.



ANOTHER!
PROVEN PRODUCT OF THE
PRACTICAL FOUNDRYMAN
BY **NATIONAL**



SIMPSON MIX-MULLER



PLANNED - PROGRESSIVE UNITS



COMPLETE FOUNDRY MECHANIZATION

for Economy:

THE FOUNDRYMAN'S CHOICE—By 4 to 1

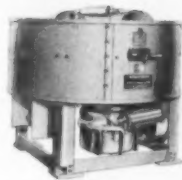
These advantages of the Simpson Mix-Muller have appealed to foundrymen since Simpson mulling replaced the shovel as a means for sand preparation.

SIMPLICITY of design provides low maintenance and long wear life. You use half the power and produce none of the heat generated by doing the same job on other equipment.

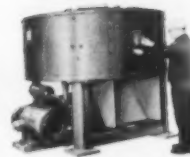
LARGE CAPACITY. You'll get more mulling per batch, per hour, per ton of sand and per dollar invested in sand conditioning equipment.

These primary advantages add up to dollar savings in scrap, cleaning costs, time, labor and maintenance. They are the reasons why, for almost 50 years, Simpson Mix-Muller has been the choice of practical foundrymen by four to one.

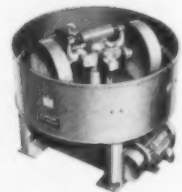
The modern, versatile F-Series Mix-Muller is now available in a size and capacity to meet any foundry requirement and for sand of any composition or formula.



Model 3F
4000 lb. batch (min.)



Model 2 1/2 F
3000 lb. batch (min.)



Model 2F
2000 lb. batch (min.)



Model 1 1/2 F
1000 lb. batch (min.)



Model 1F
500 lb. batch (min.)



Porto Muller
300 lb. batch (min.)



LF (Laboratory)
25 lb. batch (min.)

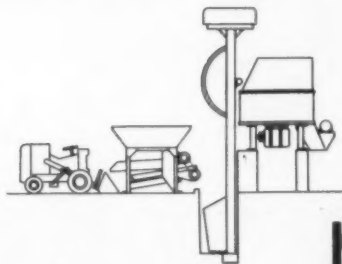
PRACTICAL FOUNDRYMEN HAVE SELECTED

NATIONAL BUDGET UNITS

GROW WITH YOU—and your profits

National planned-progressive units are designed to help small and medium size foundries realize maximum production at welcome savings in time and labor—without the expenditure necessary for major plant change and full mechanization.

These are flexible, unitized items of equipment designed to get sand overhead—to leave the molder free to mold and free your floor for fast, clean and efficient foundry operations. A glance at the equipment will show you why no foundry is too small to take advantage of the growth opportunity offered by National progressive units. Remember too, your National Representative can show you the best and fastest way to use these units so that they will pay their own way... in increased profits.

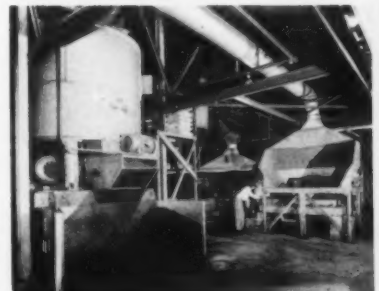


NATIONAL UTILITY UNITS

An expendable sand preparing plant consisting of a screening device with magnetic separator, elevating equipment and Mix-Muller of any size. Can be extended or altered, by units, to fit into the plans of any foundry. Is particularly well suited for the jobbing foundry. 12 months amortization is typical. Five figure savings yearly in manpower alone are reported and documented.

At Keene Foundry,
Griffin, Indiana...

Utility Unit saved over \$25,000 in a year... working conditions improved 100%... now clean a 500-ft. long floor in 3 hours—formerly took entire 8 hour shift... save \$3.40 per ton of casting... unit amortized in 3 years of operation.

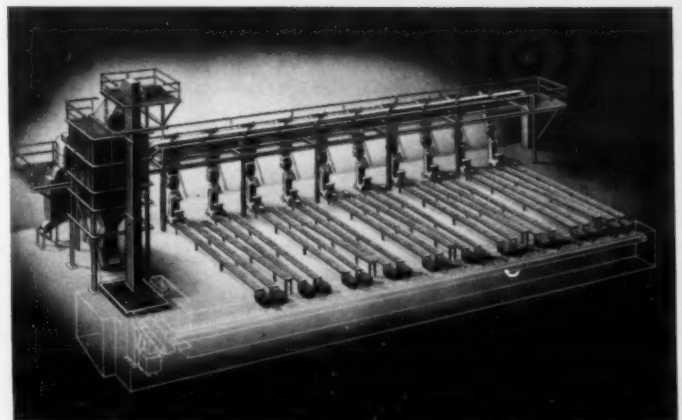


NATIONAL PLANNED-PROGRESSIVE UNITS

A MACHINE TO PRODUCE CASTINGS

National Engineering Company's most valuable asset is a background of experience which permits competent appraisal of your problem.

We regard a molding system as machine of varied and intricate parts, some human and some mechanical, which are coordinated to produce one end result—better castings. At what cost are these castings produced? At what savings in man hours? These factors must be weighed against the cost of mechanization with careful consideration given to the particular needs of your foundry. No two needs are alike. No two systems are alike. It is in the competent appraisal of these factors that your National Representative can show you how National systems pay off fast—in profits.



Here standard National units are engineered to form a complete progressive sand preparing plant using roller conveyors for mold storage, through pouring—to shakeout.

for sand quality:

INTENSIVE CONTROLLED MIXING

True mulling is the mechanical application of working pressure. It can be likened to the intensive blending achieved in a mortar and pestle. The kneading, smearing, spatulate action effected in the Mix-Muller is unique in its ability to (1) wrap each grain evenly with plasticized bond or resin; (2) effect no reduction in grain size; (3) produce no frictional heat and; (4) produce a uniform blend of any materials needed for molding.



This is how it works.

- 1 . . . the plows fold the sand to stir and repile it into the Muller path, thus insuring thorough mixing and mulling.

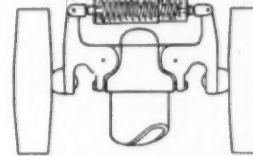


- 2 The Mullers are set off the true radius to achieve an intensive spatulate action. As they roll forward they also skid sideways to produce a sliding shearing action.



- 3 . . . the inside edges have a shorter distance to travel than the outside edges—to create rotary smearing action across the wide face of the Muller.

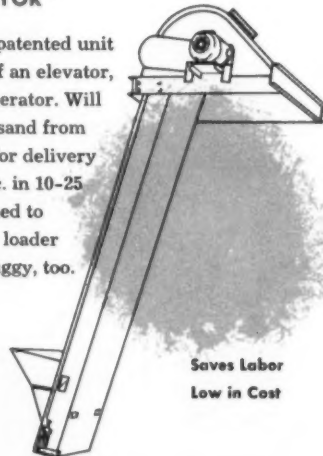
- 4 A unique feature of the new F Series Mix-Muller is the spring-loaded mullers which may be adjusted to exert the exact amount of pressure required for the sand being processed. As sand strength increases during the mulling cycle, the pressure exerted by the mullers increases to develop full properties and strength.



ELECTED SIMPSON MIX-MULLER BY FOUR TO ONE FOR A

NATIONAL "ELEVAYOR"

This unique National-patented unit has the best features of an elevator, belt conveyor and an aerator. Will elevate a full batch of sand from mixer discharge door for delivery to belt, hopper, bin, etc. in 10-25 seconds. Can be designed to receive from front end loader weigh larry or sand buggy, too.



High in Efficiency
Has 1000 and 1 Uses

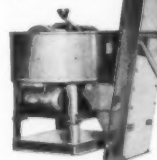
Saves Labor
Low in Cost

NATIONAL MOLDER'S HELPER

Any foundry can afford to eliminate the costly job of handling sand from mixer to molder with this compact unit. It can increase molder's production 50%, eliminate floor shoveling and concentrate your entire molding and mixing operation into more space than one molder now occupies. It's flexible, too—many standard arrangements, as shown, are available. Write for details on this inexpensive sand handling "system."

"ELEVAYOR"

MIX-MULLER
(any size 1F-3F)



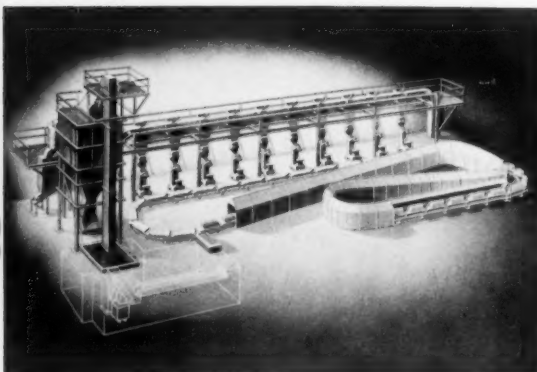
Single Molder's Hopper

Double Molder's Hoppers
(side or front discharge)

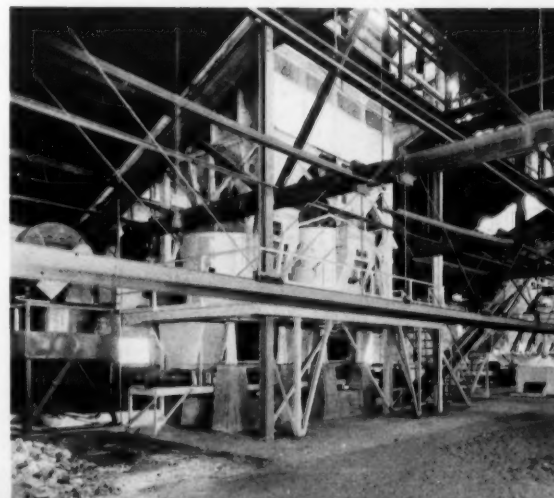
Four to six stations

E UNITS ARE GEARED TO GROW WITH YOU...AND YOUR

Here is the same layout using the National Mold Conveyor to provide efficient, continuous pouring and shakeout operations. Note simple, sturdy construction of cooling zone enclosure.



Here, though on a much larger scale, is an extension of the National units incorporated into an entire sand preparing, molding and automatic shakeout system.



MAKE THE MOST OF YOUR MIX-MULLER

with these foundry proven
auxiliaries

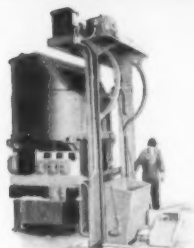
National produces a full line of sand preparing auxiliary items that are designed to (1) save you time or, (2) take the guesswork or elements of human error out of your sand control operations. All of these items are designed and built specifically for foundry use, by National, for use with the Simpson Mix-Muller.

WRITE FOR SPECIFICATIONS



AERATORS

Eliminate riddling, get free-flowing, lump-free sand at the molder's station with a National Aerator. This is a machine specifically designed for aeration. Available for mixer discharge attachment or location anywhere in the system.

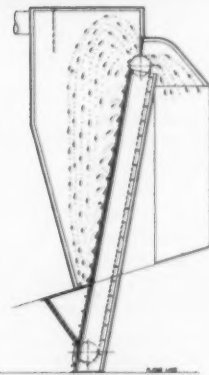


BUCKET LOADERS

Cut operator time in half with a National Bucket Loader. Eliminate over and under-charge and laborious manual charging of mixer. Save up to 50% in sand preparing time.

TIMEMASTER

Eliminate batch composition guesswork. Get full automatic control over batch makeup and mulling cycle with the National Time Master.

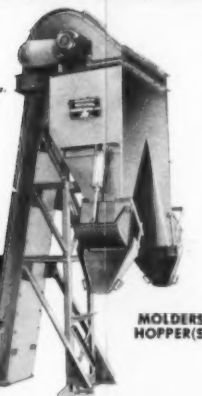


COOLEVAYOR

Cool sand before storage with the unique new "Cool-evayor". Not a mixer attachment or "also-cools-sand" device. . . . Coolevayor is specifically designed to provide an economical means to cool sand to room temperature between shakeout and mixer.

ALMOST FIFTY YEARS

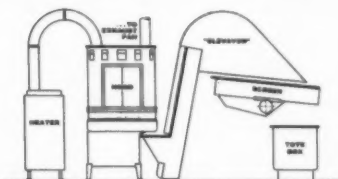
PULL OUT



MOLDERS
HOPPER(S)



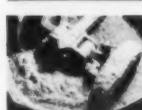
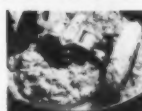
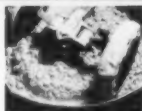
x stations (belt delivery)



NATIONAL SHELL-MULL

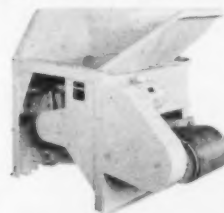
This fully integrated shell sand preparing plant is designed to incorporate any size Mix-Muller. It will provide as little as 600, or as much as 20,000 lbs. of uniformly coated, resin sand per hour. It is now used as standard shell mold equipment in over 40 foundries, including every principal auto manufacturer in the U.S.

Photos show how true mulling action blends shell mold components into a uniformly bonded, homogeneous preparation . . . quickly and expertly.



NATIONAL SCREENMASTER

This compact, easy-to-use screening unit requires no pits or foundations. Is easily incorporated into any existing installation. Is equipped with powerful ALNICO magnetic pulley, lump-breaker, vibrating screen and full thirty cu. ft. hopper.



Adjustable Lump Breaker • 30"x 60" Heavy Duty Screen

Easy Cleanup • 30 cu. ft. Hopper

Controllable vibration • no pits required

Radial Design Magnetic Pulley

R PROFITS

PULL OUT

of the basic
ng, handling;



NATIONAL HYDRO-FILTER

Here's a Dust Collector that cleans itself!

The National Hydro-Filter is an air "scrubber". Dust laden air is brought into contact with water under conditions which cause the dust to transfer to the liquid stream. It differs from conventional wet type dust collecting equipment in several ways—all of which represents radical improvement and assurance of maximum efficiency and low maintenance, over a wide range of operating conditions.

NO BAFFLES . . . to wear, corrode, or "load up" within collection area.

NO INTRICATE PARTS . . . to clean. Water action and glass spheres do the work with Hydro-Filter.

NO DEAD AREAS . . . Entire interior is constantly flushed. Every inch is used to collect dust particles.

STOPS DUST 4 WAYS

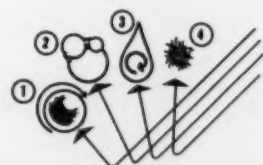
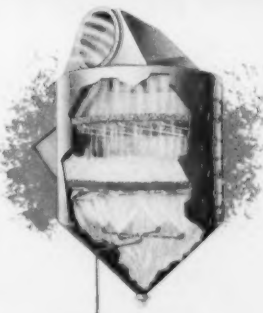
Four-way particle separation is effected as shown in the diagram at right, below.

1. Impingement on wetted surface of glass spheres.

2. Impingement on bubble surfaces.

3. Entrapment within falling water droplets.

4. Impingement on wetted interior surfaces of the collector.



THE ADVANTAGES OF PNEUMATIC TRANSPORT

Pneumatic transport of bonded materials in the foundry offers certain advantages not found in any other conveying method. This is especially true where:

Expansion of existing molding requirements must be made within limited spaces.

Where the extension of mechanical handling facilities to remote areas becomes impractical.

Where centralized preparing plants are desirable.

Here are a few of the basic advantages you get with pipe line routing.

System operates in a confined, overhead area—little floor space is required.

It's completely flexible — can be designed to operate in virtually unrestricted path.

Anyone can operate a pneumatic system. No specialized operator skills are needed. System can be made fully automatic.

Maintenance is not absent; but nature of maintenance requires less time, is less specialized and is usually more economical than with mechanical system.

Materials are transported within seconds to their destination.

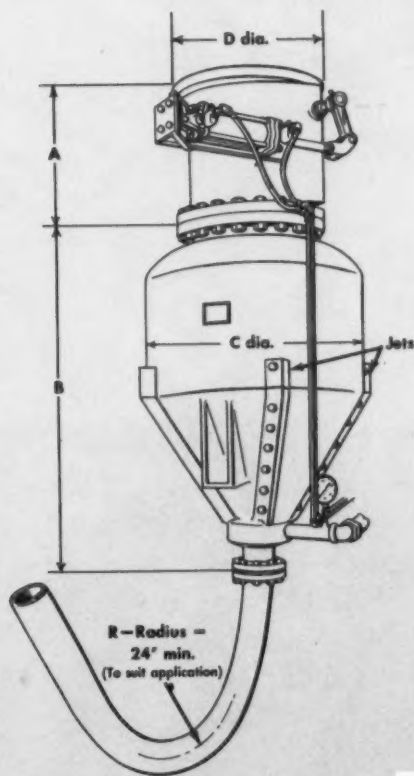
Materials are entirely confined to insure less housekeeping, cleaner operation.

PNEUMATIC TRANSPORT
THE PRACTICAL METHOD



EQUIPMENT METHOD
HOW TO USE IT TO ADVANTAGE

THIS NATIONAL IMPROVED EQUIPMENT OFFERS MAXIMUM



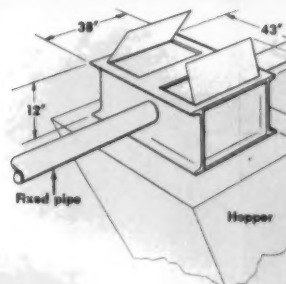
NATIONAL TRANSPORTER

THE TRANSPORTER

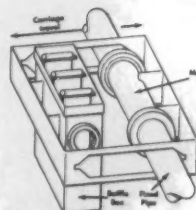
The transporter is the heart of the system. National Transporters are available in capacities of 7½, 15, 30, and 40 cubic feet. Clearance dimensions and rated capacities of various sizes of transporters are shown in the chart below. Here's what you get with this improved National Transporter:

EASY ACCESS The National Transporter sealing gate is located in a removable section at the top of the Transporter (A) which is easily accessible for maintenance and may be replaced without completely dismantling the transporter and removing it from the system.

JETS ARE ADJUSTABLE Both the size of the air jets and the jet pattern can be varied to suit requirements of the materials to be conveyed. This feature makes it possible to blow at lower air pressures and to obtain the maximum aerating efficiency. Once the jets have been set for your material, they may be locked into position. All jet adjustments can be made from the outside.



DIVERSION VALVE (Shown)



POSITIVE ALIGNMENT FEATURE



POSITIVE SAFETY-LOCK SEAL

BOOSTER FITTING Equipped with easy-open couplings



Pipelines are made 4 or 5 inch extra-high. All bends are large radiused bends. System designed by competent, qualified men who seek to minimize air consumption and keep a minimum. Boosters designed to merge pipelines wherever they can be easily moved, when necessary.

TRANSPORTER CAPACITY and DIMENSION DATA

Dimen.	7½	15	30	40
A	2'-0"	2'-0"	2'-0"	2'-0"
B	4'-3"	5'-7"	7'-0"	8'-4"
C	1'-10"	3'-0"	3'-6"	3'-8"
D	2'-3½"	2'-3½"	2'-3½"	2'-3½"

ANOTHER!
PROVEN PRODUCT OF THE
PRACTICAL FOUNDRYMAN
BY NATIONAL

TRANSPORT FOR

PRACTICAL FOUNDRYMAN

CONVEYOR

METHODS • IMPROVEMENTS
TO ADVANTAGE AND PROFIT

THE IMPROVEMENTS

MADE BY NATIONAL

In offering a *coordinated* pneumatic transport service which includes design, layout, fabrication, engineering and erection; National has been able to overcome many of the shortcomings of earlier systems. Particular emphasis has been given to:

MAINTENANCE: National systems include only the latest *foundry proven*, patented components. Where improvements in operating and maintenance characteristics were needed—National engineers have incorporated them. Many of these improvements are shown here.

ENGINEERING and LAYOUT: Each National system is backed by the practical foundry engineering experience gained in our almost 50 years of service to the industry. Because National is experienced in both mechanical and pneumatic handling, prospective customers can be assured of unbiased, expert advice and, most important . . .

FOLLOW THROUGH: National Air Conveyor Corporation is staffed and equipped to provide competent repair and parts facilities; as well as complete erection services.

MAXIMUM PERFORMANCE AT MINIMUM MAINTENANCE



THE DIVERSION VALVE OR RECEIVER

TWO-WAY ACTION The National Diversion Valve is designed to receive sand from either direction in a pipeline. This permits a dual system in which two transporters can be used to deliver sand to more than one station at a time. The feature also minimizes complete shutdown, should trouble occur at one transporter or in one leg of the pipeline.

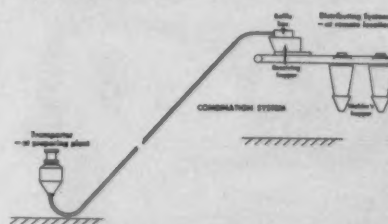
NO SWITCH AT STATION The new National Diversion Valve was developed to permit the receiving of sand at any point in a pipeline without the necessity of using a pipeline switch—normally a high maintenance item.

COMPACT The National Diversion Valve is Compactly designed to fit into close quarters and low headroom areas. It is totally enclosed to cut down housekeeping and to provide protection for the moving parts.

TYPICAL LAYOUTS

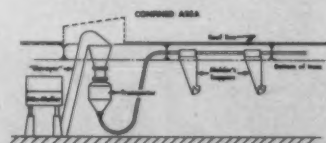
How National System can be used to profit and advantage.

Shown here are three schematic layouts which are typical of the type of installations where a properly engineered and executed pneumatic system can be used to reduce operating costs and increase production.



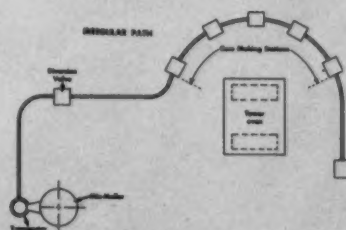
COMBINATION SYSTEM

Shows how a pneumatic system can be incorporated to provide practical extension of mechanical system to remote molding unit.



CONFINED AREA

This arrangement illustrates how a pneumatic system can put relatively small and confined space to work as a molding area.



IRREGULAR PATH

Here a pneumatic system makes it possible to locate core making or molders' stations along an irregular or circular path.

THE PIPING

made up from either extra-heavy steel pipe. large radius fabrications are laid out by qualified engineers to minimize maintenance air pressure and ion requirements to Booster fittings are merely clamp into never needed. They moved to new location necessary.

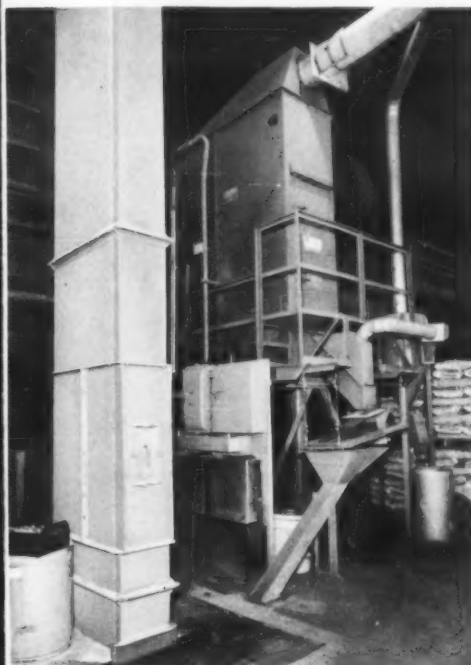
THE SWITCH

In the National system switches are kept to a minimum. None are needed at diversion points. The National line switch mechanism incorporates the same positive lock-in feature illustrated under diversion valves. They can be indexed to serve up to 14 different positions.

THE CONTROLS

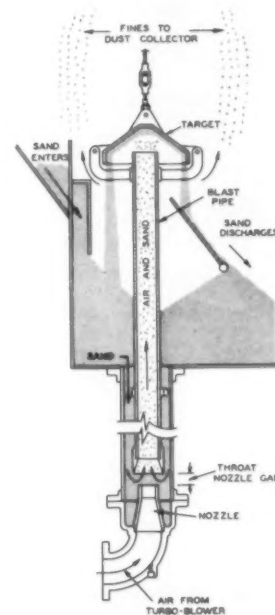
A National Air-Conveyor system is furnished with a complete set of manual controls including control valves, pressure regulator, shut off valves, and pressure gages. If desired, the entire system can be made semi-automatic so that a complete blowing cycle is started by merely pushing a button, or the system can be made to recycle automatically.

NEW SAND FOR OLD . . . NATIONAL SAND RECLAMATION SYSTEM



The National Sand Recovery System has been quickly accepted by foundry users all over the country as the proven means for the average foundry to reclaim sand at a profit. Users are reaping financial reward from reclaiming equipment that has paid for itself in as little as 12 months time. Many are compounding their savings by literally mining profits from *used sand*.

A recent study of savings among six average-volume users showed that National systems were turning in a savings of \$5,000 each per month. Since 1952, leading U.S. foundries have *proven* the practicability of the National Scrubber in over 450,000 hours of in-plant operation.



THE FOUNDRY INDUSTRY IS OUR BUSINESS

For half a century National Engineering Company has devoted its activities to the planning, development and manufacture of foundry equipment designed to help you make better and more salable castings.

Modern day sand practices saw their beginning with the Simpson Mix-Muller. Synthetic sands and the extended usage of resin bonded, CO₂ and the many new sand formulations were largely made possible by the Simpson intensive mulling principle.

National Sand and Mold Handling Equipment has brought the low cost efficiency of unitized mechanization to many foundries who were doubtful of their ability to afford growth—yet certain of their need to grow.

WHY NOT LET NATIONAL HELP YOU
TRANSLATE YOUR GROWTH NEEDS
TO PROFIT OPPORTUNITIES IN 1958?



RETURN THE CARD FOR THESE NEW NATIONAL BULLETINS

National Engineering Co.
600 Machinery Hall Bldg.
Chicago 6, Illinois

☐ National Air Conveyor
Corporation

☐ The Cooling of Foundry
Sand by R. L. McIlvaine

☐ Simpson Mix-Mullers
Series F

☐ National Sand Recovery
System

Name _____ Title _____

Company _____

Address _____

City _____ Zone _____ State _____

Printed in U.S.A.



**NATIONAL
ENGINEERING
COMPANY**

600 Machinery Hall Bldg.
Chicago 6, Illinois

Details on these products and processes are available to MODERN CASTINGS readers. See page 7-8.

ing soaking pits, de-skulling ladles, furnace tapping, and salamander removal are claimed by manufacturer to be handled faster and more efficiently by new process. Makes vertical or



horizontal cuts through any thickness of ferrous or non-ferrous metals and concrete without noise or vibration. Technical information and on-the-job assistance provided. Company's booth No. is 1301-1317. Linde Co., Div. of Union Carbide Corp.

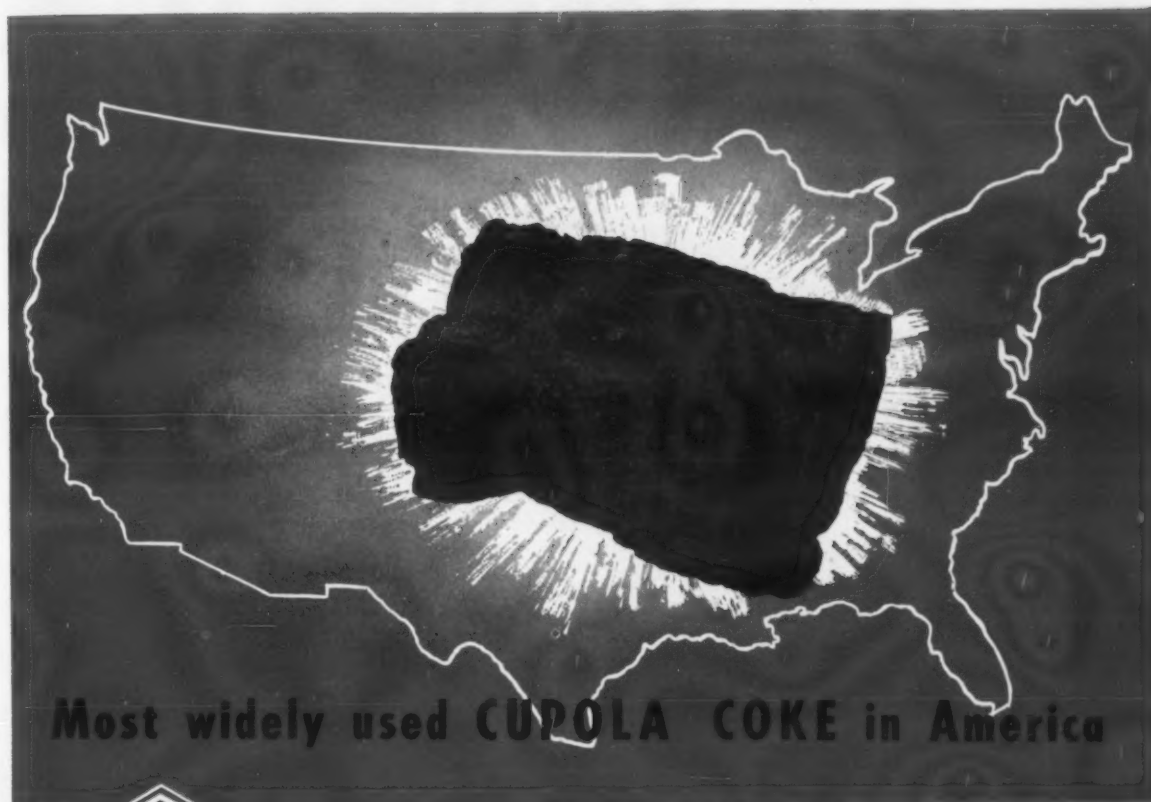
For Manufacturer's information - Circle No. 852, Page 7-8

FOUNDRY REFRACTORY GUN . . . will be shown for the first time in booth No. 911-919 at the Foundry Show. The Cupolinor SHM is one-man operated with two levers at the nozzle controlling air supply, mois-



ture, operating pressures, and rate of material feed from 75-400 lb per min. Machine said to handle fine, dry castables; all basic patching materials; and

Circle No. 931, Page 7-8



ABC FOUNDRY COKE

Last year ABC foundry coke was shipped from our modern plant at Tarrant, Ala., to more than 500 customers in 34 states, Canada, Cuba and Mexico.

Among these were several of the largest coke users in the nation and hundreds of smaller foundries—many of which have made ABC their sole source of supply for as long as 35 years.

ABC's list of customers is growing year by year—a testimonial to the quality of our coke and the dependability of ABC service at all times and under all conditions of the market.

Unlike most other coke plants, ABC has no blast furnace or other affiliations having first call on its production.

ABC foundry coke—standard or malleable—is available in sizes to meet the exacting requirements of any cupola operation.

Your inquiries are invited

ALABAMA BY-PRODUCTS CORPORATION

General Sales Office: First National Building, Birmingham, Alabama

GREAT LAKES FOUNDRY SAND COMPANY, Detroit; ST. LOUIS COKE & FOUNDRY SUPPLY CO., St. Louis; THE RANSON AND ORR COMPANY, Cincinnati; KERNER, MARSHALL AND COMPANY, Pittsburgh; BAUFORD, GUTHRIE & COMPANY, LTD., San Francisco; ATWELL COKE AND COAL COMPANY, Chicago.

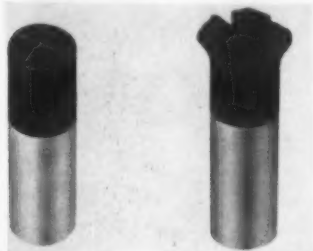
Sales Agents

Circle No. 932, Page 7-8

wet rebound reclaimed from under the cupola. Complete elimination of dust, and smooth flow of material without pulsating or clogging troubles. *Eastern Clay Products Dept., International Minerals & Chemical Corp.*

*For Manufacturer's Information
Circle No. 853, Page 7-8*

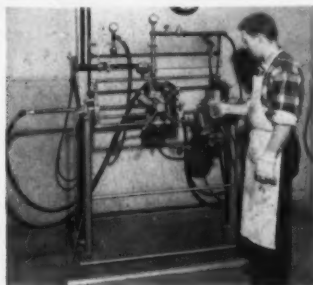
SHAPED ORIFICE TUBES . . . for special core box conditions, including an automatic valve tip tube (photo) for blowing free-flowing coated sand into hot core boxes—opens on blow,



and closes when blow-cycle ends. Tubes are available in slot form for blowing through narrow openings; a form to direct sand away from certain areas in the core box; and another form useful for corner blowing. Available in all sizes, these products will be displayed in booth No. 311. *Martin Engineering Co.*

*For Manufacturer's Information
Circle No. 854, Page 7-8*

SHELL CORE MACHINE . . . adapts to customers' core boxes with what is said to be little or no alterations. The Dependable Shell Core Machine produces small cores in four gang boxes at rate of 10 per min, and cores up to 9-in. diameters or 18-in.



lengths at rate of one per min. Said to include complete system of all automatic valves and controls preassembled on wall panel, requiring only attaching to gas and compressed air lines to start making cores. Heat applied directly to back of box by gas and air flame, at low fuel cost. Machine will be exhibited at booth No. 1010. *Dependable Pattern Works.*

*For Manufacturer's Information
Circle No. 855, Page 7-8*

Circle No. 933, Page 7-8

42 • modern castings

"UNIPAK-COATER"

**NOW—COATED SAND TO YOUR SPECIFICATIONS FROM
THIS LOW COST, COMPACT "PACKAGE UNIT!"**

Here's your answer if you now make shell molds or cores, or contemplate using coated sands. The "Unipak-Coater" by Sutter assures definite quality superiority along with maximum economy in the production of any shell core or mold. It uses all types of sands and resins, coats by either hot or cold process, thoroughly aerates the coated sand, has a top capacity of 6,000 pounds per hour, requires minimum maintenance. Other outstanding features:

- *The benefits of pre-coated sand over mechanically mixed sand and resin.*
- *The economy of using your own pre-coated sand.*
- *Positive sand-coating quality control to your own specifications.*

- *Elimination of dust problems versus dry mixing.*
- *Compact, space-saving, self-contained design.*
- *Low labor cost . . . one operator continuous system.*
- *Fully-interlocked cycle with maximum flexibility.*
- *Electrical, gas and pneumatic equipment to I.I.C. standards.*

The "Unipak-Coater" is engineered and built by specialists who know the requirements of all phases of shell mold and core making. Let us show you how this machine will positively solve your sand coating problem. Complete engineering, laboratory and plant facilities at your disposal for testing. Write for data file describing all Sutter foundry equipment.

SUTTER PRODUCTS CO.

407 HADLEY STREET • HOLLY, MICHIGAN

*World's largest manufacturer of shell mold and core making equipment—
Designers and manufacturers of many types of foundry machinery and equipment.*

VERSATILITY! Typical shell molds and shell cores, along with castings produced from them. Every mold and core utilizing various combinations of sand and resin . . . illustrating the versatility possible with the "UNIPAK-COATER."



SUTTER

BY

SUTTER

Patternmakers Can Build Success into CO₂ Process

by J. M. Venetucci
Liquid Carbonic Corp., Chicago

■ Patternmakers constructing new pattern equipment to be used in the CO₂ process should incorporate certain features into pattern and core box equipment in order to adapt this equipment to the process. Some are:

1) Allow large draft when possible—because within the core box, no movement of sand is allowed during stripping operations.

2) Eliminate deep pockets—if they show up on patterns or core box equipment, loose pieces or gaggers should be used to reduce the possibility of tearing the core.

Tapered Slots

3) Select screen or inverted slot vents—screen vents should be used with care; the mesh of screen must not allow fine particles of sodium silicate-coated sand to enter the mesh and block the passage of gas. Slotted vents must be tapered outward from inside the box.

4) Distribute vents not only for blowing design but for distribution of CO₂—too often CO₂ escapes from vents before penetrating and curing the entire core. Back pressure must be created to hold the gas long enough to completely saturate the core. If vents are too numerous, a plate should be used to block the escape of gas.

5) Seal the parting line on core boxes to prevent loss of gas—this will further increase efficiency.

Plugs Save Sand

6) Use metal or wood plugs to produce a hollow core—omitting a large volume of sand. In this method the plug is removed from the box and CO₂ injected into the core from the center, outward. The box can be removed while the gas is flowing as the core will be supported from the center while being cured. Stripping green produces a better draw. If the core is not sufficiently supported without the plug, a hollow plug may be used as a gas transfer medium.

7) Use hollow patterns in conjunction with mold facing, employing CO₂ sand—vents are placed into pattern similar to a core box, facing sand is backed with heap sand, and CO₂ is let into cavity under pressure, curing sand. Final mold has hard surface area like dry sand mold in which excellent quality castings are produced.

■ Condensed from a talk presented at Wisconsin Regional Foundry Conference.

Circle No. 933, Page 7-8

SAND
FLOW

ELEVATOR

BATCH HOPPER

SAND FEEDER AND HEATER

CENTRIFUGAL
COLLECTOR

AUTOMATIC
COVER WITH
IN-AND-OUT AIR

SAND COATER

CRUSHER

RECEIVING
HOPPER

VIBRATING
SCREEN

AIR HEATER

FEED HOPPER
AND AIRVEYOR

SUTTER

See the "Unipak-Coater," Shell Core Blower and Exhibit of Shell Cores, Molds and Castings at the Foundry Show, Cleveland, Booths 2124 and 2223.

SAND
HOT?



NATIONAL COOLEVAYOR

AT LAST...
a practical, low cost solution
to Hot Sand problems

Foundrymen have long realized the need for a competent *separate*, yet economical device to cool sand before storage. National Engineers have devoted several years to the development of such equipment because they wanted to develop a unit that would meet these qualifications and cool sand *fast*.

The National COOLEVAYOR is fast, efficient and extremely compact. It requires little more room than an elevator. It can, in fact, be used in *place* of an elevator or conveyor. The design permits a maximum time for air-sand contact and a maximum area for heat transfer. You'll notice in the drawing at right that a virtual *sand storm* is created within the generous sized housing.

The result? Coolevayor is designed to cool shake-out sand to within the range of room temperature—as it enters the muller or storage bin. Temperature drops of 100° and more, from 200°+, have been experienced—even on days of high humidity.

SEND FOR BULLETIN

What we found out about cooling foundry sand during development of the Coolevayor makes informative reading for *anyone* with a hot sand problem. That's why we have recorded these findings in a new bulletin entitled **THE COOLING OF FOUNDRY SAND**. A copy will be sent to you free, upon request.

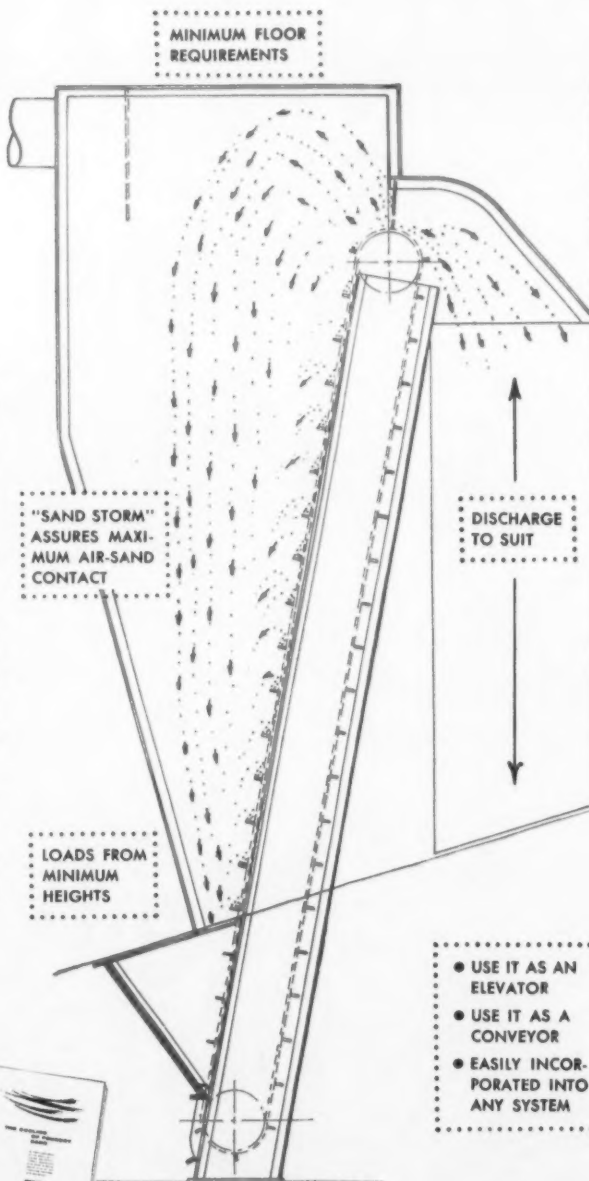


ANOTHER!
PROVEN PRODUCT OF THE
PRACTICAL FOUNDRYMAN
BY NATIONAL

NATIONAL ENGINEERING COMPANY

630 Machinery Hall Bldg. Chicago 6, Illinois

Circle No. 934, Page 7-8



See the COOLEVAYOR
at the FOUNDRY SHOW.

Hints for Efficient Core Blowing of Wood Boxes

by Z. MADACEY
Beardsley & Piper Div.,
Pettibone Mulliken Corp., Chicago

■ All foundries today, whether highly specialized, semi-jobbing, or jobbing, can blow their cores successfully and economically. With recent improvements in core blowers, sands bonded with oil, dry binders, resins or silicates, can be blown successfully into metal, plastic or wood core boxes *provided box and blow plate are properly rigged*.

Preventive Measures

Blowing cores into metal core boxes usually does not present any difficulty. It is essential, however, that some preventive measures be taken when blowing into wooden core boxes. In general, they are rigged and blown without vents. Some of the preventive measures follow:

1) The vent area in the blow plate used must be adequate and the sand magazine full when blowing. If air instead of sand is blown into the box, the best-constructed wooden core box will not stand up under the air pressure.

2) If the magazine is full of sand, the box properly rigged, and it still blows apart, then probably a joint seam is too large. This condition allows air and sand to leak through, causing the box to separate at the joint.

3) Care must be taken that too much air is not being used to move the sand required to fill the box. Core box damage and destruction can result even if the magazine is full of sand and there are no parting line leaks. If too much air is your problem, blow-hole diameter should be increased. The larger the hole, the less air required to fill the box; this means less erosion on the core box surface.

Use of Agitator

4) Sand too high in green strength and deformation packs in the magazine. Blowing such sand into core box may require air pressure too high for box to withstand.

When this condition exists, an agitator in the magazine will keep sand from packing tightly, allowing sand to be moved by a normal volume of air. Keep your magazine full of a sufficient amount of sand.

■ Condensed from a talk presented at the Wisconsin Regional Foundry Conference.

Circle No. 935, Page 7-8



ELIMINATE ACCIDENTS

USE COLOR-CODED BRIQUETS

Briquets are the most convenient method of adding alloys to the cupola charge—additions are made by count and weighing is eliminated.

Like other briquets, all Ohio Ferro-Alloys briquets contain an exact weight of alloy. But, only the unique OFAC system of Color Coded Briquets can offer you positive identification of the different elements. Like the stoplight, it's the time-tested system of control.

Write for Your FREE Copy of our brochure —
"BRIQUETS IN THE IRON FOUNDRY"



**YELLOW
SILICO-MANGANESE
BRIQUETS**

**RED
MANGANESE
BRIQUETS**



**GREEN
CHROMIUM
BRIQUETS**

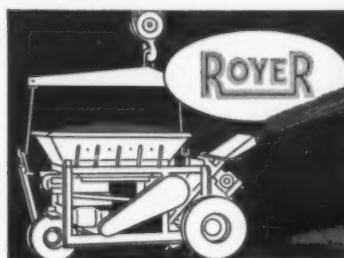


**GRAY
SILICON
BRIQUETS**

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*Ohio Ferro-Alloys Corporation
Canton, Ohio*



SAND CONDITIONING TOPICS

PUBLISHED BY ROYER, MANUFACTURERS OF THE FOREMOST IN SAND CONDITIONING EQUIPMENT

ROYER OFFERS A PRACTICAL SOLUTION TO HOT SAND PROBLEMS

In today's foundry operation, time is probably the most costly element the superintendent must deal with. Sand used for today's casting must be conditioned and ready for use tomorrow. This frequently means sand conditioning at temperatures ranging up to 300° to 400°F.

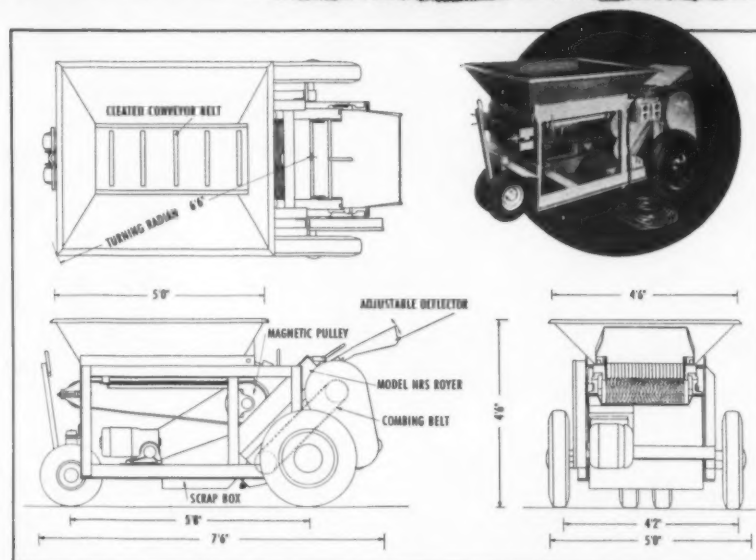
These destructive high temperature operating conditions seem to plague every foundryman. Foundry equipment suppliers have offered many possible solutions—cooling towers, shake-out belt cooling, water cooling, rotary cooling, bin cooling, etc. But probably no manufacturer has offered more thorough cooling per dollar of invested capital than that obtained with Royer equipment.

All Royer Foundry Units employ the famous Royer Belt Combing Principle. In operation, a combing and mixing action takes place in the feed hopper. This breakdown of the hot sand mass releases the hot gases as the first step



in Royer Cooling. Further cooling of the individual sand particles takes place as the conditioned sand is discharged in an open stream. And finally, the sand heap, now open, light and fluffy, continues cooling at a very rapid rate.

There is a Royer Foundry Unit to solve every sand conditioning problem. Your inquiry is invited. We promise prompt reply—without obligation.



Sand Conditioning costs can be reasonable

When any industry suffers a business recession, however slight, the attention of its leaders automatically shifts to cost cutting and the elimination of waste. Many foundrymen peer wistfully at the large, highly mechanized foundry and imagine semi-automation is the answer.

Looking at the foundry industry realistically, this form of advanced mechanization is not the answer. Seventy-two per cent of the nation's foundries employ less than 50 men—for most of these, advanced mechanization is both a physical and an economic impossibility.

For these foundries, units like the highly efficient Royer MAGNA-SAN are the practical solution to most sand conditioning cost problems. Here is a unit that is foundry-engineered to magnetically clean, mix, blend and aerate shake-out sand right on the molding floor—and at a lower initial cost and with less maintenance than any other mechanical method.

The Royer MAGNA-SAN is ideally designed for use in the small and medium sized foundry—this 73 per cent who most need the advantages of mechanization but cannot pick up the bill. Compare this compact unit, in the drawing above, with your available working space.

Notice how the compact design permits easy maneuvering about crowded casting floors.

Capacity-wise, the Royer MAGNA-SAN conditions 45 tons of sand per hour—a full 8 per cent more than its closest competitor. And remember, it is a fact that economy of operation is determined by performance, which is measured by comparative expense per ton of sand conditioned.

We invite you to see for yourself how reasonable sand conditioning costs can be. Send the coupon and we'll rush your copy of the MAGNA-SAN Bulletin RM57 to you by return mail.

ROYER FOUNDRY & MACHINE CO.



155 PRINGLE STREET
KINGSTON, PENNA.

I want to know more about reasonable sand conditioning costs. Rush me your MAGNA-SAN Bulletin.

NAME _____

COMPANY _____

ADDRESS _____

CITY _____ ZONE _____ STATE _____

obituaries

Herbert B. Luria, 55, president, Luria Steel & Trading Corp., and president, Luria Engineering Co., New York, died March 11. He founded the company which is reportedly one of the leading designers and constructors of industrial buildings.

Howard Bierman, president, Acme Foundry Co., Minneapolis, died recently. He was a member and former Director, AFS Twin City Chapter.



Howard Bierman

Frank J. Neudorf, secretary-treasurer, Sheffield Foundry Co., Chicago, for the past 28 years, died March 14. He had been affiliated with the company for 39 years.

John J. Boland, Sr., 71, formerly operating assistant, Foundry Div., Griffin Wheel Co., Chicago, died March 14. He joined the company's Chicago plant as a clerk in 1907, becoming superintendent of the Detroit plant in 1920. Transferred back to Chicago in 1931, Boland was operating assistant for the firm at the time of his retirement in 1947. He assisted in development of the mechanical molding process for chill-iron grinding wheels, and also helped to develop an efficient use of tellurium to control chill.

MORE FACTS on all products, literature, and services shown in the advertisements and listed in **Products & Processes** and in **For the Asking** can be obtained by using the handy Reader Service cards, pages 7-8.

Circle No. 937, Page 7-8



"No machining complaints since I used SMZ alloy"

You can eliminate chilled corners and hard spots in gray iron castings with ladle additions of "SMZ" alloy. Machining rates can thus be improved by as much as 25 per cent, giving you more satisfied customers.

"SMZ" alloy is the most widely used inoculant in the iron foundry industry. As little as 2 to 4 pounds of "SMZ" alloy per ton of iron are sufficient to eliminate chill in light castings. For harder irons of lower carbon and silicon contents, a larger addition of the alloy may be required.

For information on how "SMZ" alloy can improve the machinability of your castings, contact your ELECTROMET representative. Ask for the booklet, "SMZ Alloy—An Inoculant for Cast Iron."

ELECTRO METALLURGICAL COMPANY, Division of Union Carbide Corporation, 30 East 42nd Street, New York 17, N. Y.



Visit ELECTROMET's exhibit at the AFS Castings Congress and Foundry Show, May 19-23.

Electromet
FERRO-ALLOYS AND METALS

**UNION
CARBIDE**

The terms "Electromet," "SMZ," and "Union Carbide" are registered trade-marks of Union Carbide Corporation.

"What is a sound way for
foundry management to
realize anticipated profits
today?"

"Through a
Knight Engineered audit
of operating efficiency."

**Knight
services
include:**

Foundry Engineering
Architectural Engineering
Construction Management
Organization
Management
Industrial Engineering
Wage Incentives
Cost Control
Standard Costs
Flexible Budgeting
Production Control
Modernization
Mechanization
Methods
Materials Handling
Automation
Survey of Facilities
Marketing



Lester B. Knight & Associates, Inc.

Management, Industrial and Plant Engineers

Member of the Association of Consulting Management Engineers, Inc.

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917 Fifteenth St., N.W., Washington, D. C.

New York Office—Lester B. Knight & Associates, 375 Fifth Ave., New York City 16

Knight Engineering Establishment (Vaduz), Zurich Branch, Bahnhofstrasse 17, Zurich, Switzerland

Through experience gained from impartial, objective analysis of hundreds of foundries in this country, Canada, Europe, and South America, Knight Engineers are qualified to determine whether full utilization is being made of facilities and manpower—the balance between profit and loss today.

The Knight organization can help you decide quickly on the most modern equipment and techniques that are economically justified, and to determine what must be done to insure full utilization of man hours and machine capacities.

Knight Engineers have carried out such programs for grey iron, steel, malleable, brass and bronze, magnesium and aluminum castings from a few ounces to 100 tons in weight.

*Call or write the Knight organization without
obligation to see whether your operation can
benefit from this comprehensive experience.*

Pig Iron, Steel Produced Directly from Iron Ore

■ Iron ore can now be directly reduced to pig iron or semi-steel. The new process, announced jointly by Strategic Materials Corp., Buffalo, N. Y., and Koppers Co., Pittsburgh, Pa., is comparatively simple, using a rotary kiln, an electric furnace and standard materials handling.

A hot charge of iron ore, flux, and bituminous or anthracite coal is directed from the kiln into the reducing zone of the electric furnace where complete reduction takes place. Slag additions can be made to control impurities and so produce a metal equivalent to or superior to pig iron with respect to such elements as silicon, phosphorous and sulfur.

The metal may then be cast into pigs or transferred in molten form to a refining furnace where it may be alloyed to produce steel or iron for castings. Tests indicate the following advantages for the process:

- 1) Flexible regarding ore size—ores including flue dust are used without special preparation. Those tested required no agglomerating, sintering, briquetting or nodulizing.
- 2) Complex ores which are now of little value may be used.
- 3) Latitude in selection of reductant and fuel—coal, peat, lignite or coke may be used.
- 4) Can control of carbon content.
- 5) Low power requirements.
- 6) Low initial capital costs.
- 7) Can be used for large installations or for units producing as little as 50 tons per day.

Engineering and cost studies indicate the commercial feasibility of the process for use near ore sites and where relatively inexpensive electric power is available. The process does not appear to be immediately competitive at existing major steel production centers.



"Looks like Gilmartin finally submitted a beneficial suggestion that might be accepted."

Centrifugal Casting Meets Precision Specifications

■ Pouring with exacting temperature control is one phase of foundry technique employed by Airesearch Mfg. Co., Los Angeles, to extract the full potential of High Purity 356 Alloy.



Using centrifugal casting methods, the company is reported to get 44,000-lb ultimate tensiles from test coupons. Aircraft cabin compressor wheels are said to pass whirl pit tests with a 50 per cent and greater margin over specification.

New Association Promotes Castings for Aircraft Use

■ A new organization to promote the sale of castings to the aircraft industry has recently been incorporated in California. The Aircraft Casting Association has as its goals:

1) To promote and develop an extended interest, acceptance and use of ferrous castings manufactured from non-expandable patterns among companies manufacturing aircraft, missiles and related products.

2) To achieve and maintain a high standard of quality for the products to be offered to such industries.

3) To cooperate with government agencies on matters of interest to this industry.

4) To promote the research and development of quality ferrous castings for the aircraft, missile and related industries.

5) To promote the general welfare of ferrous foundries serving the aircraft, missile and related industries.

Member companies include: Pacific Alloy Engineering Corp., El Cajon, Calif.; Lebanon Steel Foundry, Lebanon, Pa.; High Integrity Cast Alloys, Inc., Shreveport, La.; Electric Steel Foundry Co., Portland, Ore.; General Metals Corp., Oakland, Calif.; Hanford Foundry Co., San Bernardino,

Continued on page 50



NEVILLE FOUNDRY COKE

NEVILLE Foundry Coke is scientifically processed from clean, washed coals containing a high percentage of Pocahontas. We provide this extra measure of quality at the very beginning of our foundry coke production. And it carries right through to help you produce more high quality castings.

Neville Foundry Coke is a dense, strong uniform coke, with more fixed carbon and less ash and sulphur. That's why it consistently provides maximum melting temperatures which enable you to produce a hotter, cleaner, more fluid iron.

**Neville Pig Iron and Neville Coke
for the Foundry Trade**

If you're interested in improving the quality and increasing the efficiency of your gray iron castings production, specify *Neville* the next time you order foundry coke. And if you need any technical help, our engineers will be glad to meet with your production people.



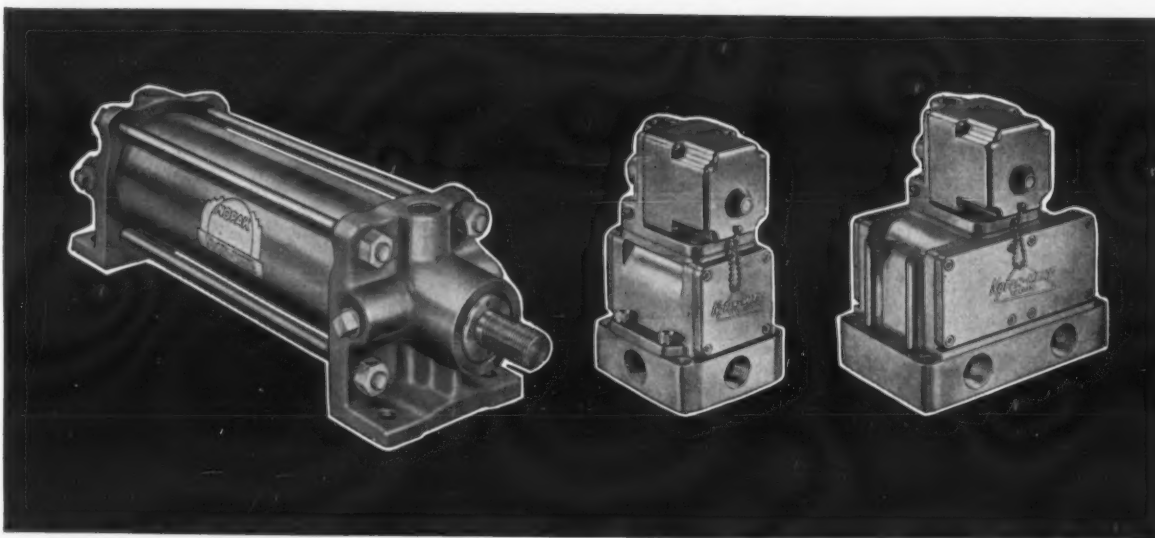
NSW 7088

COKE • CEMENT • PIG IRON • COAL CHEMICALS • PROTECTIVE COATINGS • PLASTICIZERS • ACTIVATED CARBON

Circle No. 939, Page 7-8

May 1958 • 49

It's NOPAK for fluid power products



When you specify . . . specify Nopak Valves and Cylinders and you are assured of efficient, low-cost performance that will confirm your good judgment through many years of trouble-free service—even under severe working conditions. The wide selection of Nopak air and hydraulic products meets your fluid power requirements.

A Great Team! Nopak Air Cylinders are being used to great advantage with the new Nopak-matic, Pilot Operated, Air Control Valves. Together they have proved a great team in many successful "in plant" and O.E.M. applications. Send for Nopak Catalogs 101 and 105 for complete engineering and application data.

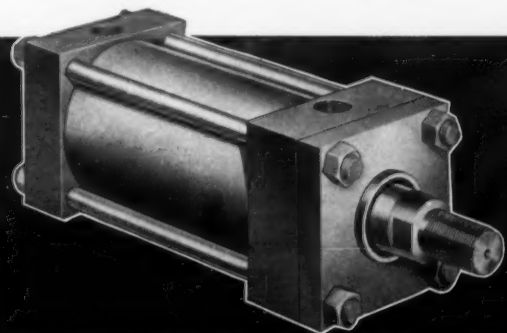
NOPAK Class 1 and 2 Air Cylinders are available in 7 standard mountings in bore sizes from 1½" to 14" with a choice of non-cushioned, self-regulating or adjustable cushioned heads on all models. Class 1 Cylinders, in most standard sizes, are available from Shelf-stock at the factory and other convenient locations. Write for Shelf-stock listings.

Nopak-matic Valves—Nopak-matic, Pilot-operated Poppet-type Air Control Valves are available in ¼", ¾", 1½" and 2½" pipe sizes for 2- or 3-Way normally open or normally closed operation, and 4-Way operation. Master (air), single or double solenoid control heads interchangeable on all models. All valves available, as standard, with choice of side or bottom ported sub-plates. Air pressures to 150 p.s.i.

New NOPAK Square Head Design

Hydraulic Cylinders give you quality, delivery, price, and complete interchangeability with most units of this type. This new line of Nopak Hydraulic Cylinders offers a complete selection of standard mounting styles (15) plus many combinations; a complete range of bore sizes (1½" thru 8"); operating pressures to 2000 p.s.i. and 3000 p.s.i. non-shock; proven design and construction.

Investigate the advantages — you'll specify NOPAK Square Head Hydraulic Cylinders! Send for Catalog 103.



See us at the
FOUNDRY SHOW
Cleveland, May 19-23
Booth No. 2213

NOPAK VALVES and CYLINDERS

GALLAND-HENNING NOPAK DIVISION • 2799 South 31st St. • Milwaukee 46, Wis.

Aircraft Castings

Continued from page 49

Calif. and Stanley Foundries, Inc., Huntington Park, Calif.

Association officers, who also comprise the board of directors, are as follows: president, A. M. Slichter, Pacific Alloy Engineering Corp.; vice-president, C. E. Haney, Electric Steel Foundry Co.; and secretary-treasurer, W. W. Stevens, Jr., Stanley Foundries, Inc.

■ For information regarding membership, circle No. E, page 7, 8.

Forecast of Aircraft Metal Research Needs is Released

A five and ten year forecast of metals research requirements has been released by the Aircraft Industries Association. Components of aircraft and missiles must be capable of efficient operation at temperatures at 2000 F for a few-min duration, and 1200 F prolonged exposure.

Present thinking in the aircraft industry is that major emphasis should be directed as follows: 1) Evaluation of the properties; corrosion resistance, ductility, heat treating, welding and brazing at sub-zero temperatures to 1200 F. Improve fabrication of precipitation hardening semi-austenite steels. 2) Evaluate properties and improve fabrication of air hardening stainless and alloy steels aimed at tensile strengths above 300,000 psi. 3) Complete evaluation of sandwich and other panel constructions for high temperature use. 4) Continued development of various heat-resistant alloys of the iron, cobalt and nickel-base types. 5) Increase strength and reduce cost of titanium. 6) Development of methods for protecting readily oxidizable materials, such as molybdenum, at elevated temperatures. 7) Development of beryllium metal or alloys. 8) Further development in the field of fiber metallurgy.

■ For more information and copies of the complete report, circle No. D, page 7, 8.

All A.S.T.M. Iron Casting Standards Now in One Book

■ All of the standards relating to iron castings established by the American Society for Testing Materials have, for the first time, been published in a single volume. The new publication contains 32 standards relating to pig iron, gray iron castings, cast iron pipe, nodular iron castings, malleable iron castings, welding rods and electrodes and general methods of test.

■ For additional information and price, circle No. F, page 7, 8.

Stress Analysis Testing Improves Castings Design

■ Since the construction of a Stress Analysis Laboratory in 1955, Central Foundry Div., GMC, Saginaw, Mich., found this new foundry approach to be extremely useful in the improvement of casting design and the search for new applications. It often provided proof that the casting process can produce a better part at a lower cost than any other method.

Parts to be tested are given a uniform coating of brittle lacquer which cracks under simulated operating conditions, indicating the areas of strain. Calibration bars and scales are then used to measure the strains applied to the part. For routine work, the strain measurements thus obtained are satisfactory.

However, when a critical job is undertaken requiring more precise measurements, a second step is added wherein strain gages consisting of fine wire in the form of a grid are applied to the strain areas indicated by the brittle lacquer method. The strain gages permit extremely accurate electrical measurement of strain.

Until recently, tests on proposed casting designs were static results obtained by simulated service conditions reproduced in the laboratory. Since these tests may not exactly represent true operating conditions when the parts are in service, Central Foundry Division has purchased portable dynamic testing equipment to evaluate new casting designs under actual operating conditions. This equipment is presently mounted in a station wagon to obtain dynamic strain readings of test parts on this automobile.

Wanted: Pictures of Plant Operations and Equipment

■ An appeal for photographs showing foundry operations, materials and equipment has been issued from the United States Department of Labor. The pictures, which are to replace out-dated photographs in the department's files, will be used in government publications and exhibits. Photos of specific in-plant operations as well as general views, plants and plant construction are needed.

Where practicable, proper credit will be given photos submitted. The department hopes in time to complete a library of photographs covering all principal industries and representing modern American industry as a whole. Send your pictures to Director of Information, Publications & Reports, U. S. Department of Labor, Washington, D. C.

Another Quality Product by **PENN-RILLTON**

FOR BETTER SAND MOLD CASTINGS

PENN-RILLTON
KILN DRIED HARDWOOD
WOOD FLOUR

Enlargement shows cross-section of casting made without P-R Wood Flour. Note scab and rough surface.

Cross-section of casting made with P-R Wood Flour. Sand expansion defects have been eliminated.

Yes, **PENN-RILLTON** now has wood flour. The grading is uniform, and the material meets the standard of quality required of all our products. It is a kiln-dried hardwood wood flour . . . low in ash, moisture, and extractable matter . . . the basic content being pure cellulose. Production testing has revealed these characteristics:

- Assists the clay and stabilizes the varying strength of the sand during pouring.
- Increases flowability of sand mixture through a sand system.
- Improves shakeout.

GET THESE ADVANTAGES

- 1 Reduces sand expansion defects such as scabs, buckles, and rat-tails thus lowering scrap losses.
- 2 Mold costs are reduced because flowability of sand is increased.
- 3 Time is saved, less equipment needed due to improved collapsibility.
- 4 Needs only ½ to 1% with new sand and as low as ¼ % with reused sand.
- 5 Permits hard ramming.
- 6 Cuts down shakeout time; improved shakeout saves sand.

Ask your supplier or write direct

BOOTH
1318
ARCADE

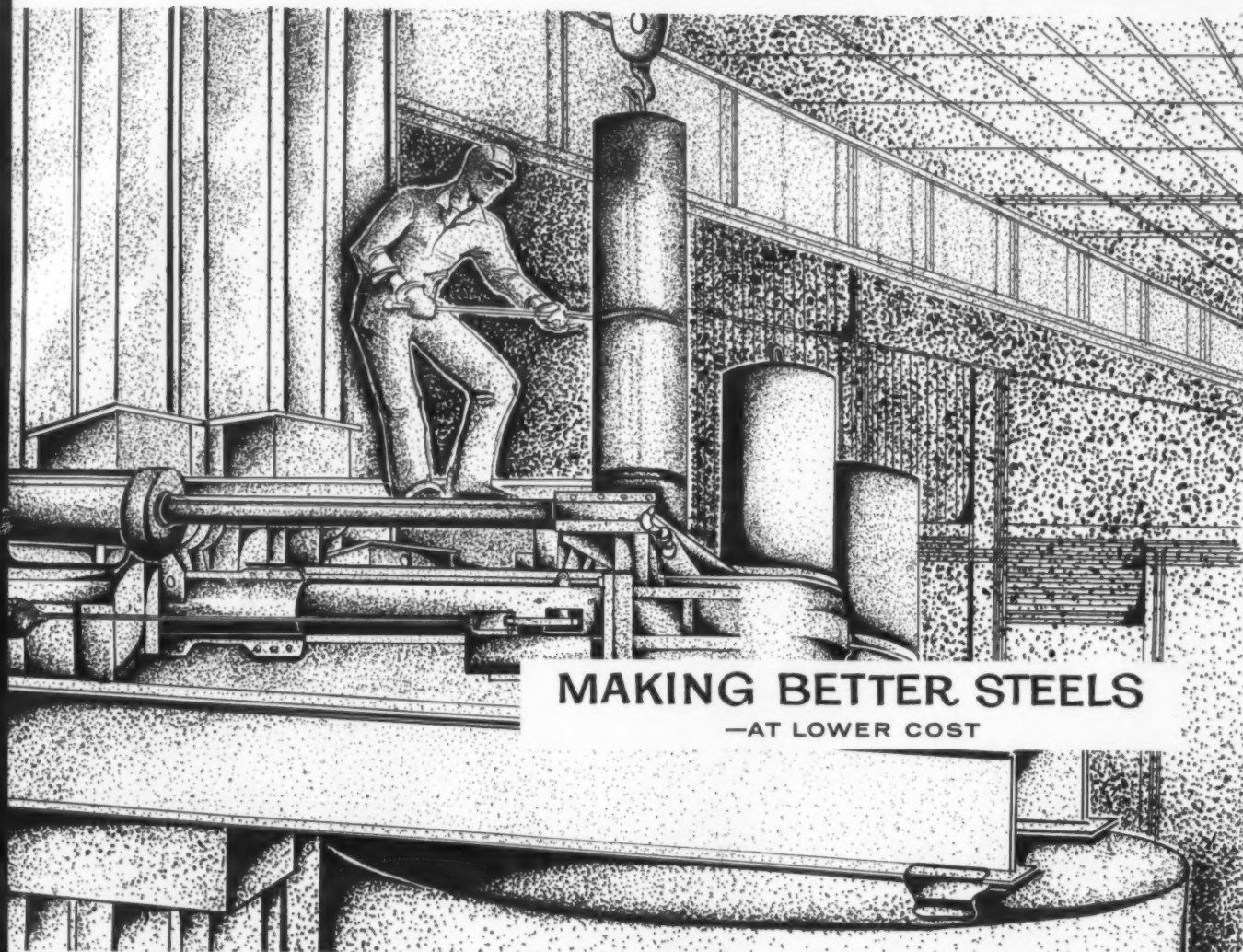


Manufacturers of:
Faceamol Spray-On, Hygeia Seacoal,
Hygeia Nu-Bond Pitch, Blended Core
Compounds
PLANTS: Irwin and West Elizabeth, Pa.

PENN-RILLTON COMPANY

326 West 23rd Street, New York 11, N. Y.

Circle No. 941, Page 7-8



MAKING BETTER STEELS —AT LOWER COST

ADDING

... to the electrode column combines the melter's art and science of knowing how and doing it right.

The joints of a GLC graphite electrode column are made tighter by using the "weld-strength" Unitrode® nipple—a revolutionary new aid to making better steels at lower cost.

FREE—This illustration of one of the skills employed by the men who make the metals has been handsomely reproduced with no advertising text. We will be pleased to send you one of these reproductions with our compliments. Simply write to Dept. C-5.



GREAT LAKES CARBON CORPORATION

18 EAST 48TH STREET, NEW YORK 17, N.Y. OFFICES IN PRINCIPAL CITIES

Internal Water-Cooled Cupola

by R. J. AYLWARD and J. GOUDZWAARD
Neenah Foundry Co.
Neenah, Wis.

R. J. Aylward and Jack Goudzwaard spoke before the 1957 Wisconsin Regional AFS Conference on the subject of water-cooled cupola operation using independent water jackets or water glands in the melting zone. Water cooling enabled a one cupola operation through two shifts requiring from 200-250 tons in 17-19 hours of melting per day from a No. 8 cupola.

Water jackets were selected in examining different types of water cooling available for the following reasons: 1.) Cost. Jackets were cheaper method of going to water cooling as they require none of the extensive shell changes necessary in external water cooling. 2.) Installation time. Jackets were installed over a weekend at no loss in production time. 3.) Low operating cost. Between 60-80 gal. of water-per-minute at an approximate cost of \$8.00 were used. The cooling water then flushed slag from front slagging spout and was also utilized in emission collectors on top of the stack. Life of jackets was good and maintenance costs low.

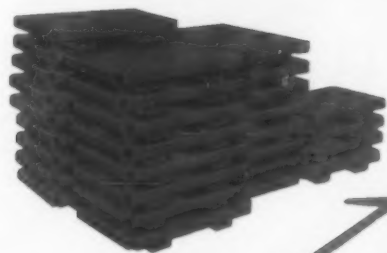
Initial installation of jackets was directly against cupola shell and the cupola was similar to any other normal acid cupola with expectation of a 350-400 F hot blast.

The first installation was not too successful because 6-7 in. of blown-in refractory was required to reach normal melting zone and burn-out between top tuyere plate and bottom of jacket was severe.

Present installation consisted of moving jackets inward 4-12 in. reducing blown-in refractory necessary to 1-2 in. This changed the nature of the operation considerably because of melting on water-cooled surface through most of heat. Serious silicon loss through last half of heat was experienced along with creation of secondary melting zones on top of jackets. Slag analysis during this period showed very high oxidation but the problem was overcome by setting limits on blast volume from 8000 cfm minimum to 9000 cfm maximum. Tuyere ratio was reduced to 12.5 per cent. Effect of net changes produced a more uniform and deeper blast penetration.

Circle No. 943, Page 7-8

Circle No. 942, Page 7-8



Announcing **another New Sterling product!**

all aluminum squeeze-in bottom boards

made from high
tensile aluminum . . .



TO insure even greater
"on-the-job" ease in handling,
Sterling engineers have developed
another improved product for
the foundry industry. This time it's
all aluminum squeeze-in bottom boards.

These newly engineered boards are fabricated
from high tensile aluminum which we have named Sterling
PERM-ALUM. This highly ductile alloy weighs about $\frac{1}{3}$ as much as
steel, while retaining its tensile strength up to 47,000 lbs. psi. Sterling
PERM-ALUM bottom boards also provide complete resistance to corrosion.

After extensive squeeze, shakeout and radiated heat foundry testing,
Sterling PERM-ALUM bottom boards remain torsionally rigid . . . no
fracturing or cracking, even when molds are left on boards until cold.

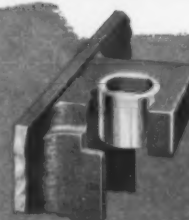
While available in standard sizes, 10" x 10" to 18" x 20", Sterling
PERM-ALUM boards can be custom-built to meet your
individual requirements. Perforations can also be provided.
The boards are reinforced with welded aluminum battens and
have rolled safety edges to protect the hands.

STERLING WHEELBARROW COMPANY
MILWAUKEE 14, WISCONSIN, U. S. A.
Manufacturers of Foundry Equipment for Almost a Half Century

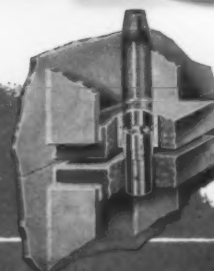


PERM-ALUM is approximately
 $\frac{1}{3}$ the weight of
STEEL!

• Standard
Hardened Steel
Ground Bushing



• Stub Pin
Shift-proof.



• No. DF4-S
Heavy duty
Wheelbarrow.



• No. 110 Core Truck
Pneumatic Tires.



• No. 137 Heavy Duty Cart
with 3-point landing.

Dependable

Sterling
long life

FOUNDRY EQUIPMENT

You can produce better castings at lower cost with dependable Sterling foundry equipment. Custom-built for heavy duty foundry service and high speed production schedules, Sterling equipment is backed by almost a half-century of specialized experience fabricating foundry flasks and equipment to the highest quality standards. Write today for copy of new Sterling Catalog.



• Style "BLST" Flask
with steel handles.



• Style "3/8 ND-RTX Cope and
3/8 NS-RT Drag" Flask with
heavy duty clamps and
clamping bars.



• Style "LST" Flask with
steel trunnions and
tubular steel handles.



• Style "E" Flask with
pin lugs and handles
combined.

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to visit STERLING Booth No. 1321
at the **FOUNDRY SHOW**
May 19-23 • Cleveland Auditorium

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STERLING FOUNDRY SPECIALTIES LTD.,
ENGLAND
Sales Offices at London and Bedford
Factories at Bedford and Arrow-on-Tyne



patent review

Automated Core Blower

High production rates are promised by an automatic mold or core blower that blows, draws, and repositions the pattern or core box for the repeat cycle. Five core boxes can go through the production cycle simultaneously.

The basic components of the device are the blowing unit, an indexing table, a rock-over mechanism, and filled core boxes from the turntable and inverts them for the drawing operation and then returns the empty stations being located at the blower.

The rock-over device takes the boxes to the turntable for indexing into position for another blowing operation. *Pat. No. 2,783,50 issued March 5, 1957 to Leon F. Miller and assigned to Osborn Mfg. Co.*

Stainless for Welding

Precipitation hardening stainless steel castings of the 17-4 PH grade can be arc-welded when the copper content of the metal is controlled.

It has been found that the copper content, which imparts the desirable precipitation hardening qualities, causes the undesirable welding qualities. Remedy is to maintain copper between core boxes through a cycle including five different stations, two of such the conventional manner, while the turntable is adapted to transport five a draw table. The blower operates in one and three per cent by weight, in-*No. 2,784,083, issued March 5, 1957* stead of the usual four per cent. *Pat. to George E. Linnert and William C. Steel Corp.*

Other Patents

Investment mixer. 2,777,177, E. A. Steinbock.

Continuous metal-casting apparatus. Patent No. 2,779,072, N. P. Goss.

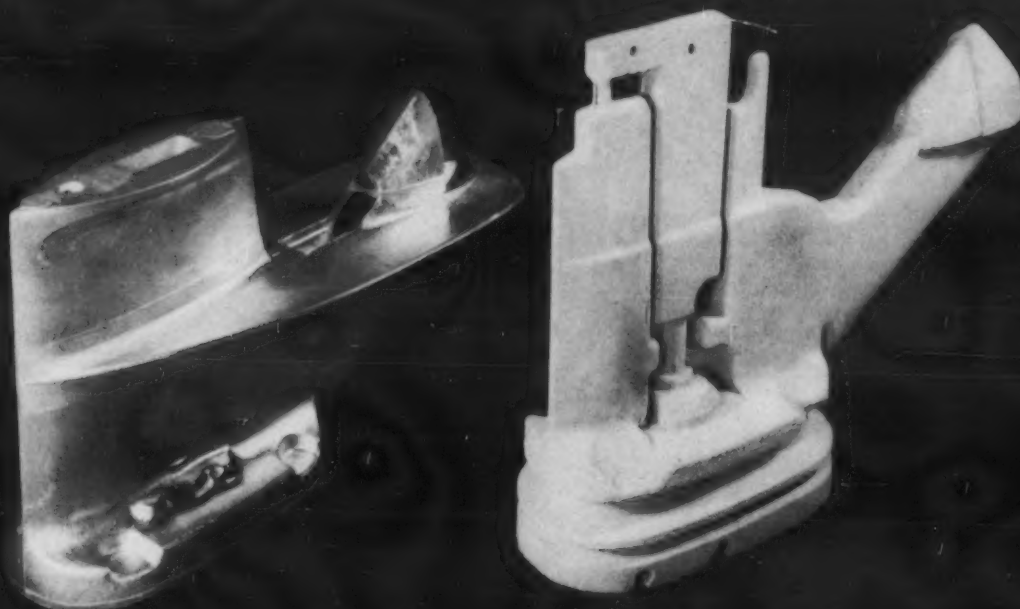
Receptacle for molten metal. Patent No. 2,779,073, H. B. Osborn, Jr.

Method of casting railway car wheels. Patent No. 2,779,075, Griffin Wheel Co.

Machine for casting aluminum pistons. Patent No. 2,780,849, O. C. Berry.

Continuous casting of aluminum. Patent No. 2,781,562, Imperial Chemical Industry Ltd.

PRECISION CORE



Casting and core for upper gear housing of outboard motor.

made with



in 15 seconds

This intricate *one piece* core was made in 15 seconds with CO₂—a feat virtually impossible by any other method. That's another example of what CO₂ can do for you!

The CO₂ process insures accuracy and dimensional stability. At the same time, it saves money by reducing labor costs and by eliminating the risks involved in baking and handling.

Write for our free report on other applications of the CO₂ process. Our engineering staff is always ready to work with you.

Visit Us at the Foundry Show
Booth 1525



LIQUID CARBONIC

DIVISION OF GENERAL DYNAMICS CORPORATION
3166 South Kedzie Ave., Chicago 23, Illinois


Please send me a full report on core and mold making with CO₂.

Name _____ Title _____

Company _____

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City _____ Zone _____ State _____

World's Largest Producer of 
**LIQUID
CARBONIC**

DIVISION OF GENERAL DYNAMICS CORPORATION
Chicago 23, Illinois

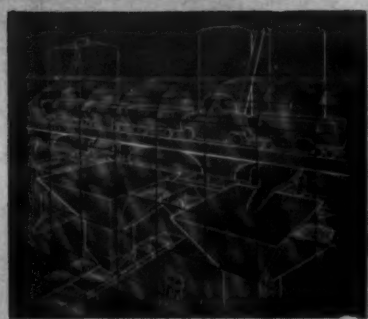
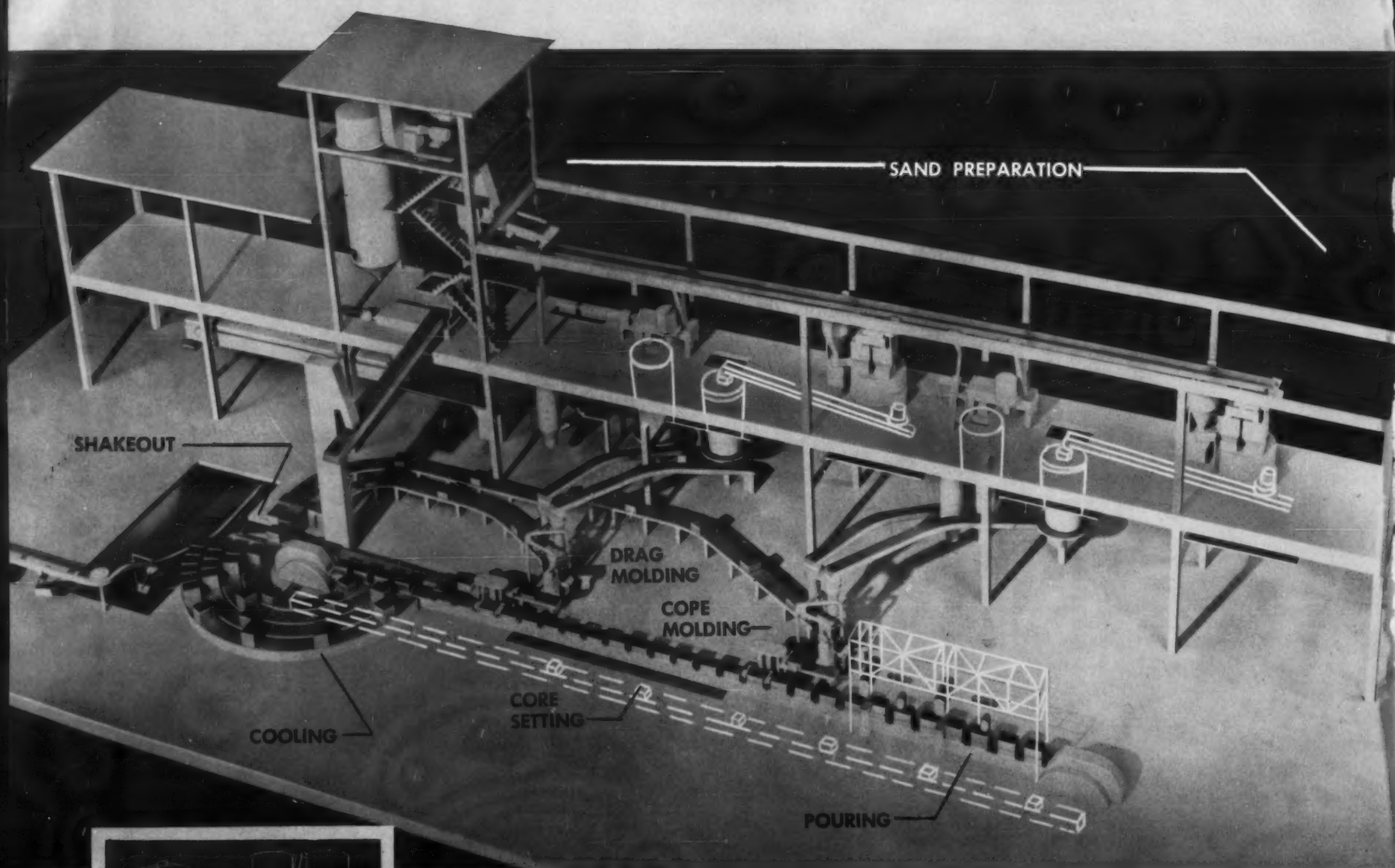
Circle No. 943, Page 7-8

Circle No. 944, Page 7-8

May 1958 • 55

THE FOUNDRY OF TOMORROW IS HERE TODAY

World's first completely automated foundry is product of the Swiss and American engineering



Scale model of the George Fischer Ltd. Automated Foundry shows main conveyor in foreground with pouring section at right and mold cooling and shake-out at left. Two molding automats, one for the drag and one for the cope-mold, with their mold transfer and closing units, produce the molds and place them on the moving conveyor. Cores are set manually before the automatic closing station, and weights are then mechanically set on each mold. Predetermined exact weight of molten metal for one mold is bottom

tapped from holding ladles into small pouring ladles which automatically pour each mold on the moving conveyor. Poured molds are conveyed below the floor level to the cooling sections which permit variable cooling times before the molds are automatically shaken-out, and the flasks returned to the molding automats on separate return conveyors. In the background is the automatic sand handling plant which incorporates a new type of sand cooler for the hot shakeout sand.

Yes, the foundry of tomorrow is here today—in Schaffhausen, Switzerland. The automated foundry of George Fischer Ltd. is a miracle of production resulting from the combined efforts of George Fischer's engineering staff, American Automation Corp. and Erwin Buhner, prominent European foundry consulting engineer.

Six years were spent in the planning, engineering, building and installation of this ultimate in automation which in 2-shift operation is capable of producing up to 36,000 tons of malleable iron castings per year with only 9 men required for its direct operation.

A maximum of 300 complete molds per hour can be turned out by the twin molding automats—one mold every 12 seconds!

Versatility and flexibility of the system to handle short or long runs of many casting sizes were designed into the system through the use of quick-change sectional pattern plates in metal, wood or even plaster; top-of-cope open runner system; and variable mold cooling times.

The controls of the Buhner foundry system are entirely pneumatic-mechanical. Through a carefully integrated program cycling system, the following operations are performed automatically: molding of drag and cope molds, mold transfer, mold closing, weighing, pouring, cooling, shakeout, flask and sand handling.

After one and one-half years of successful operation it has been decided to make the entire system available to the foundry industry in this country through the facilities of the American Automation Corp., Ann Arbor, Mich.

Numerous American foundrymen returning from European visits have brought back enthusiastic reports of the unusual capabilities of this automated system to solve many of the high-production problems facing our casting industry today.

Many of the details of design and planning that went into this plant will be described by A. H. Homberger in his talk at the Sand Division Dinner, 62d Castings Congress and Show, in Cleveland on May 20. A motion picture film of the George Fischer installation will be given its premiere U. S. public showing at this time.

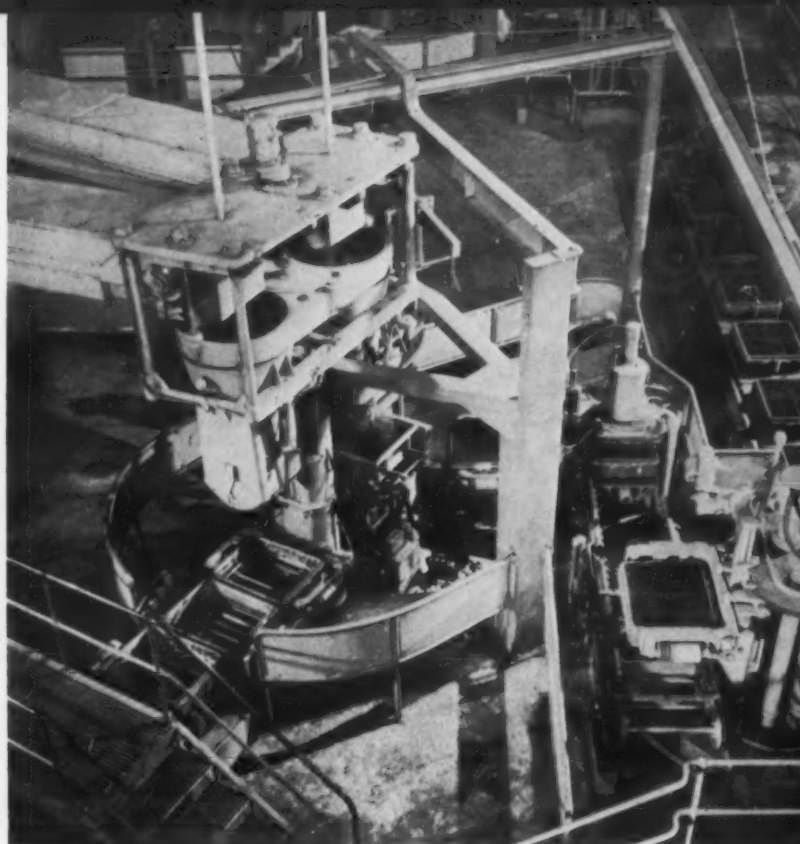
AUTOMATION IN



THE FOUNDRY

In the two schematic plan views below of the three-station Buhner molding automat, you can follow the movement of flasks into, within and out of the molding station. System uses two such molding automats, one for making drags, the other for copes. Three different pattern plates are shown on the machine. Empty flasks move in on a roller conveyor from the upper left-hand corner. Flasks are transferred by a mechanical flask gripper which rotates horizontally 180 degrees, placing flask on the pattern at Station A.

At Station A the facing and then the back-up sand are dropped into the flask, and mold is pre-compacted by jolting. Mold moves to Station B where it is jolt-squeezed and stripped from the pattern. Molds are moved 180 degrees horizontally, drags rolled over so parting face is up, and placed on the mold transfer unit. Drag transfer unit moves molds 180 degrees horizontally and places them on conveyor at bottom. Cope transfer unit sets copes on drags as they

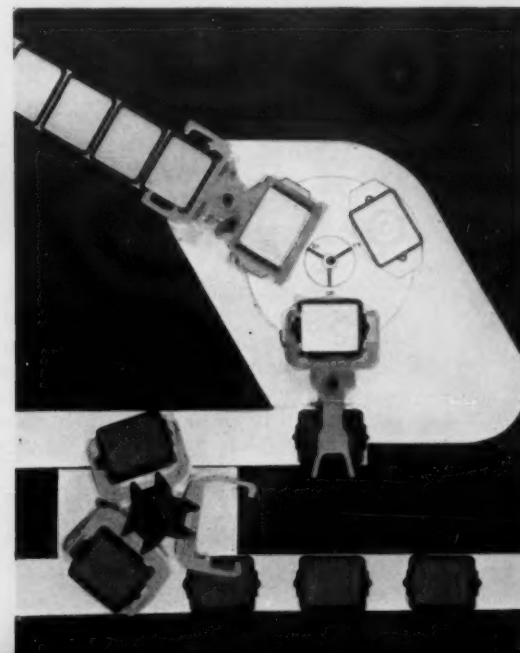
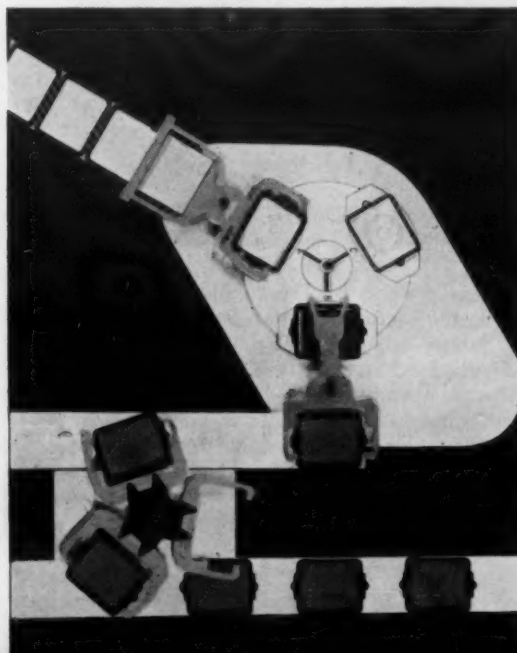


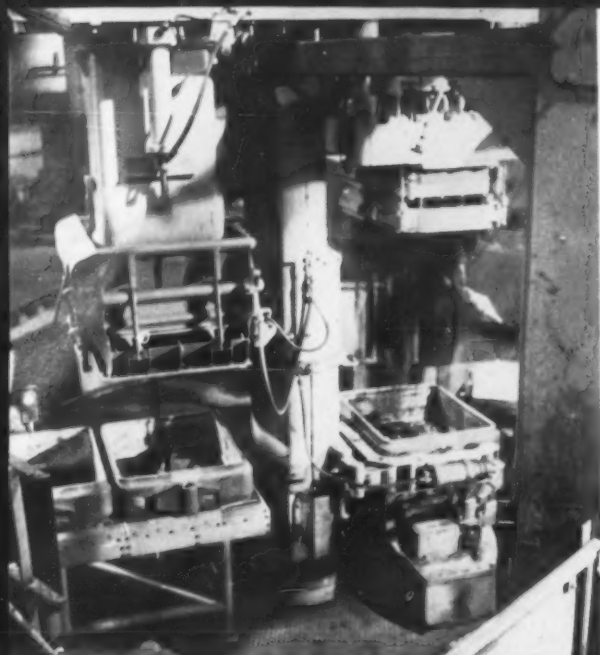
MOLDING

pass by on mold conveyor.

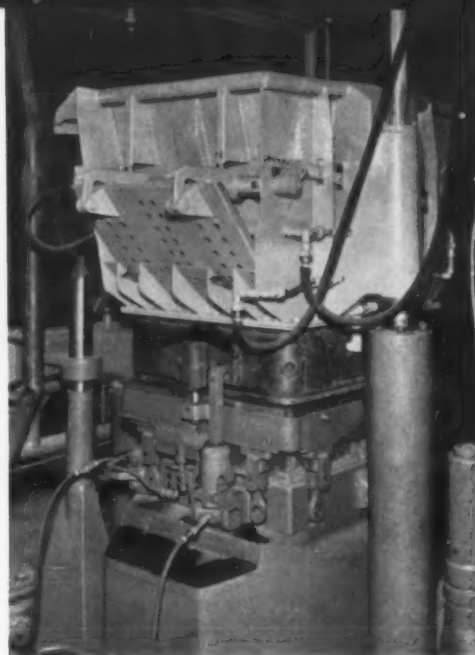
Photo of drag molding automat (above) shows, in the upper left-hand corner, two belt-conveyors used to deliver facing and back-up sand from the main storage bins located below the

sand-mixing units. Sand falls into two small silos, passing first through a riddle. At the lower right is the transfer unit which places the finished mold onto the moving main conveyor seen at the extreme right of this picture.





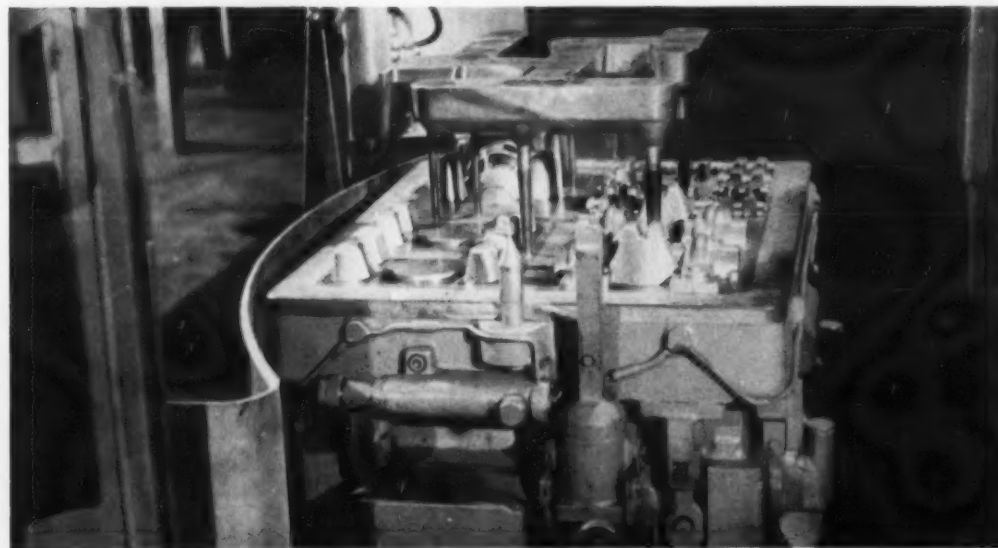
First photo shows molding automat flask entrance station, flask in position on pattern, and facing sand falling in fine streams from oscillating grid above. Measuring hopper on left is receiving proper quantity of back-up sand. It then swings into position over the



pattern plate and is pneumatically clamped to flask (center photo). Sand is emptied into flask and pre-compacted with a few strong, damped jolts. Shear plates mounted on the bottom of the measuring hopper close and strike off top of mold. Hopper now moves



away and mold indexes to Station B for final jolt-squeezing. Pattern is vibrated as automat carefully strips mold absolutely perpendicular to pattern plate using a pair of air operated grippers applied to vertical gripping surfaces on opposite side walls of the flask.



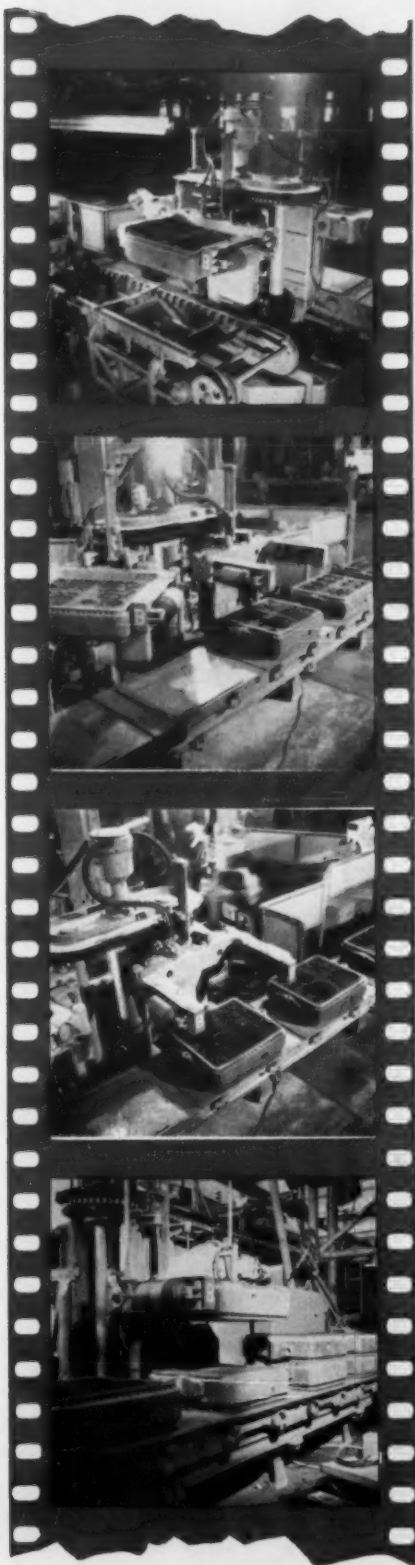
Pattern for the top runner system is shown placed in position on top of the pattern plate. A versatile runner system was designed to serve the multiple pattern segments in use. Oversize runner channels are molded into top side of each cope. The system interconnects the various down sprues needed to feed individual patterns on the plate. Top runner system is large enough to serve as pouring basin and actually holds all—or nearly all the metal required to fill mold, thus permitting rapid dumping of ladle. However, only enough metal is actually poured into the system to fill mold up to top edge of down sprues, giving good casting yield. Pattern for runner and sprue system is drawn automatically by special gripping device just prior to stripping of mold.



CHANGING PATTERN PLATES

To permit a variety of different size castings to be run on a single pattern plate simultaneously, pattern may be mounted on either a full plate or a plate occupying 3/4, 1/2, 1/4, 1/8, and/or 1/16th of the plate area. An ingenious clamping frame was designed to permit changing any section of pattern plate in an elapsed time of only one min.

MOLD TRANSFER



This sequence of pictures shows how the almost human robot transfers the finished drag molds to the main conveyor line. If any cores are required in the mold they are hand set as the drag moves toward the mold-closing station.

Bottom picture shows cope transfer unit in position to set cope on drag as it moves by. Mold closing is a delicate operation requiring flask to be held steady, exactly parallel to the parting plane. The movement onto guide pins and final closing is slow and gentle. Grippers holding the flask are similar to those used in the stripping operation. A predetermined amount of pressure is applied on cope before releasing to insure intimate sand to sand contact of parting faces.



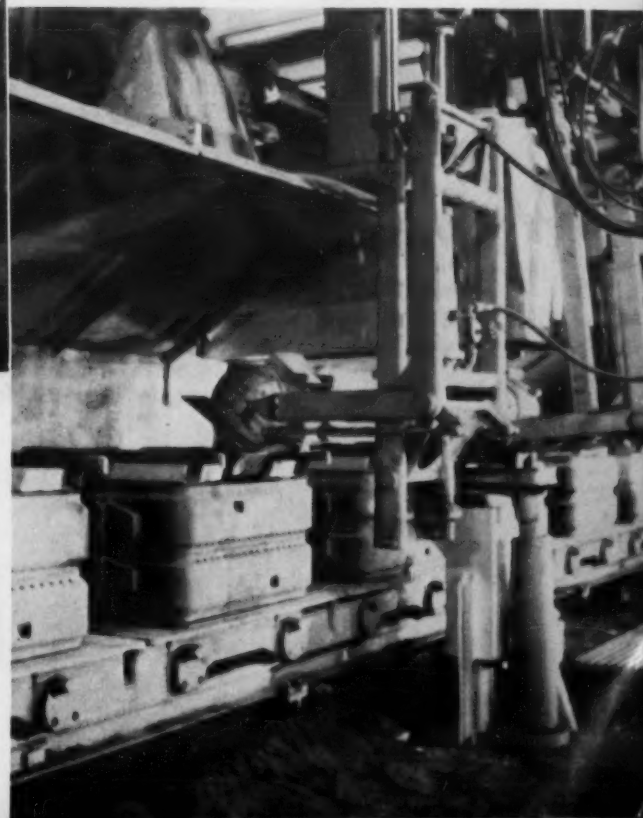
receive the exact amount to fill one mold from a stopper-operated, bottom-pour, holding-ladle above. The top runner system of mold is made oversize to act as a high-capacity pouring basin, thereby permitting rapid dumping of the metal from the ladle.

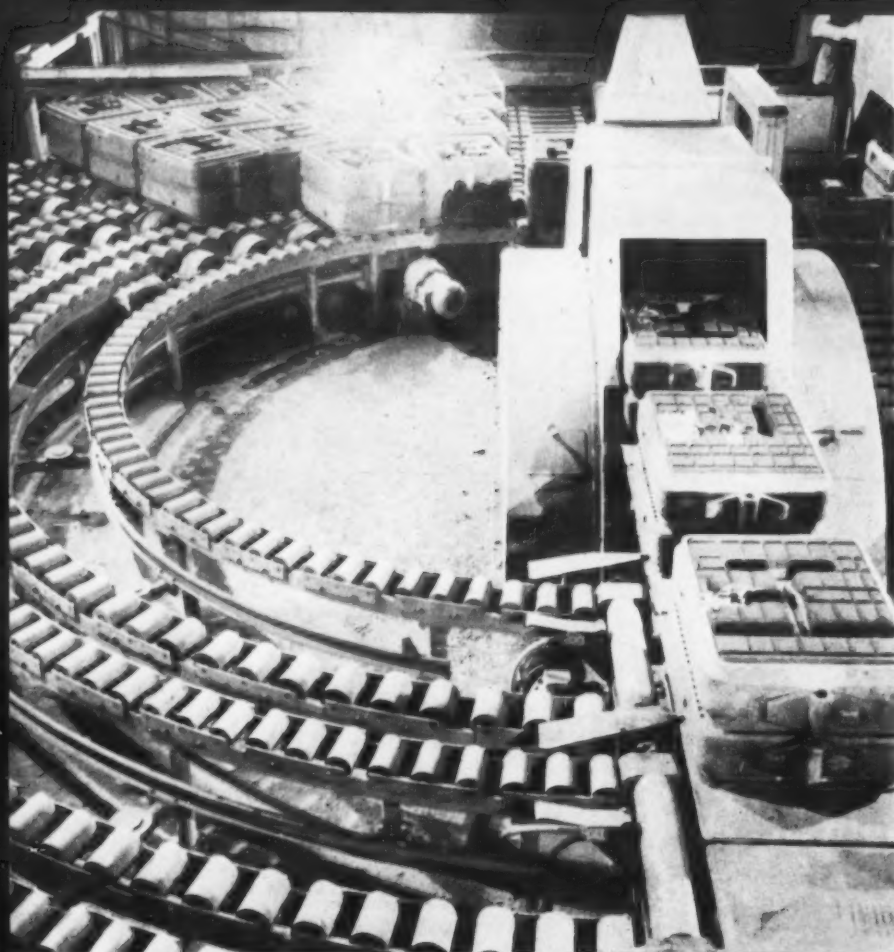
The tilting mechanism is designed to rotate the pouring ladles around a virtual axis through the lip with tilting speeds adjustable for both rapid filling of top runner system and for subsequent holding of this level. Each of the three ladles operating at this station can pour 100 molds per hour.

POURING

Mold weights are suspended from two endless chains moving at a speed and angle that permits placing them with smooth, jolt-free action. Weights are placed on the chain exactly to correspond with the space between molds on the conveyor.

Conveyor chain disappears below floor and reappears at other end of pouring line, where it picks the weights off the mold, carries them over the pouring section and back to the incoming molds. Weighted molds move into the pouring area where small ladles





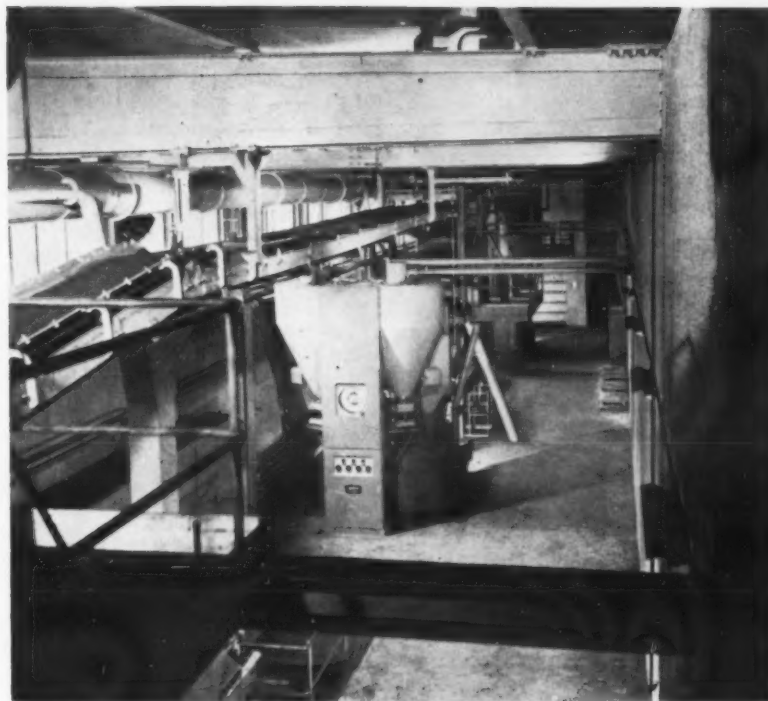
COOLING

Molds pass from the pouring section underneath the floor and are lifted again on the opposite end to the individual mold cooling conveyors. Different lengths, together with variable accumulations of molds on each cooling conveyor, permit correct cooling time for each mold.

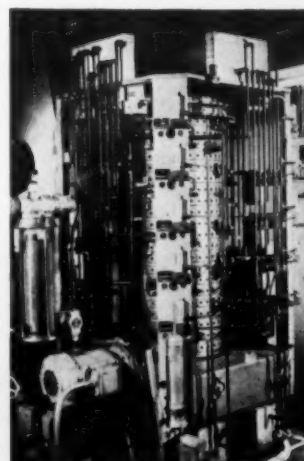
SHAKEOUT

In shakeout, flask damage is avoided by holding it firmly against a shakeout frame, where it is emptied of sand and castings with 3-4 damped jolts. Cope flask is then lifted off drag and the two are placed on their respective conveyors to return to the molding automat. The hot shakeout sand is returned to the reclaiming plant where it first passes through a new type sand cooler. This cooler is designed to effectively cool the sand without the loss of fines (and therefore re-usable binder) before reaching the reconditioning units.

SAND PREPARATION



Before the hot sand can be returned to the system from shakeout, it must be cooled. The Fischer foundry accomplishes this cooling by utilizing the evaporation heat of water. From cooling, the sand is fed over a magnetic pulley through a vibrating screen to a main distribution belt leading to the various sand-mixing units. Backing sand is prepared in two paddle mixers with only moisture added. Return sand for facing is reconditioned in mullers where additives are automatically weighed and introduced into the facing mix. From mixing, sand passes through an aerator to a storage bin where it remains only about 30 min before it is conveyed back to the molding automats.



BRAIN OF SYSTEM

Although the molding automat may be the heart of the Buhrer system, the brain that integrates this maze of complex activities is shown here. This program cyclor is a rotating drum with cams mounted on its periphery to actuate at the proper time the standardized rotary air valves controlling each operation in the foundry.

OFFICIAL CONGRESS PROGRAM OF TECHNICAL SESSIONS

Use this official program for the 62d Castings Congress to plan your visit to Cleveland during the period May 19-23. Over 85 papers covering the most advanced metal cast-

ing technology have been prepared by 137 authors. Pictures of many of these top men of the foundry industry appear throughout these pages.

The program will help you plan those busy days when you are trying to divide your time between technical sessions, luncheons, dinners, shop courses, and the show.



J. S. Schumacher



C. K. Donoho



H. Fairfield



M. Glassenberg



R. LeMaster



R. S. Zeno



A. H. Hesse



W. A. Aschoff



O. C. Nutter



E. G. Vogel



W. A. Snyder



R. G. Powell



E. Poirier



R. B. Parker



W. R. Lyubey



R. W. Ruddle



M. E. Brooks



R. W. Heine



A. B. De Ross



W. C. Truckenmiller



M. V. Davis



I. Feinberg



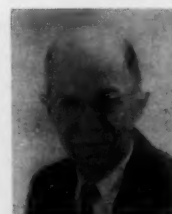
T. E. Barlow



C. E. Wulff



J. P. Moehling, Jr.



E. J. Eckel



R. V. Scalco



D. Margenstern

OFFICIAL PROGRAM — MONDAY, MAY 19th

7:30 am Author — Chairman Breakfast Ohio Room, Statler Hotel

8:00 am Registration opens

8:30 am Exhibits open

9:00 am Ladies' registration opens

9:30 am

Malleable

Club Room A, Auditorium

Observations on Pin Hole Defects in White Iron Castings

R. W. Heine, University of Wisconsin, Madison

Steel Scrap Specifications for Duplexing Cupola White Iron

R. H. Greenlee, Auto Specialties Mfg. Co., St. Joseph, Mich.

Your Foundry and Preventive Maintenance

C. E. Fausel, Central Foundry Div., G.M.C., Danville, Ill.

Pattern

Club Room C, Auditorium

Construction of Shell Mold Pattern and Core Boxes

W. A. Wright, Woodruff & Edwards, Inc., Elgin, Ill.

Gating and Riserling Shell Mold Pattern Equipment

D. C. Kidney, Westinghouse Air Brake Co., Wilmerding, Pa.

Steel

Club Room B, Auditorium

Improving Electric Furnace Refractory Life by Special Shell Cooling Techniques

V. J. Howard, Oklahoma Steel Castings Co., Tulsa, Okla.

Some Factors Affecting the Toughness of Mild Steel Castings

H. H. Fairchild and J. A. Ortiz, Los Angeles Steel Castings Co., Los Angeles

The Electric Arc in Melting Furnaces

W. E. Schwake, National Carbon Co. Div. Union Carbon Corp., New York

12:30 am

Steel Round Table Luncheon

Pine Room, Statler Hotel

A Metallurgical Report on Russia

W. R. Hibbard, General Electric Co., Schenectady, N. Y.

2:30 pm



F. Wallace



S. L. Gertsman



O. E. Johnson

Sand

Club Room B, Auditorium

Investigation of the Hardening of Sodium Silicate Bonded Sand

C. E. Wulff, University of Wisconsin, Madison

Sodium Silicate for the CO₂ Process

E. A. Lange and R. E. Morey, U. S. Naval Research Laboratory, Washington, D. C.

CO₂ Core Experience in a Malleable Foundry

G. Nestor, National Malleable & Steel Castings Co., Cleveland

Pattern

Club Room C, Auditorium

Pattern Standards for Practical Foundry Usage

E. A. Geary, Trafford Foundry Div. Westinghouse Electric Corp., Trafford, Pa.

Forum: "Where Do We Start? — You Must Tell Us!"

D. T. Kindt, Kindt-Collins Co., Cleveland; R. L. Olson, Dike-O-Seal, Inc., Chicago; H. A. Burton, Canadian Steel Foundries, Montreal, Que.

Malleable

Club Room A, Auditorium

Annealing of Malleable Iron: Effect of Repeated Annealing on Rate of Second Stage Graphitization

J. E. Rehder and J. E. Wilson, Canada Iron Foundries, Ltd., Montreal, Que.

Salt Bath Heat Treatment vs. Quench and Temper: Standard and Pearlitic Malleable

P. W. Green, General Electric Co., Erie, Pa.

Malleable Microstructures Effect and Cause—Report of Controlled Annealing Committee

L. R. Jenkins, Wagner Malleable Iron Co., Decatur, Ill.



A. E. Murton



T. W. Seaton



N. H. Keyser



J. Zotos



R. B. Brenda



Dr. F. Hofmann



A. E. Tull



A. W. Hare



J. A. Ortis



H. F. Taylor



W. P. Huelsen



J. F. Ellis



J. B. Caine



W. N. Brammer



H. A. Laforet



E. H. King

Light Metals

South Hall A, Auditorium

Problems Encountered in Casting Reactive Metals

W. A. Aschoff and D. H. Blair, Oregon Metallurgical Corp., Albany, Ore.

A Casting Technology for Reactive Metals

F. W. Wood, S. L. Ausmus and E. D. Calvert, U.S. Bureau of Mines, Albany, Ore.

Foundry Characteristics of a Rammed Graphitic Mold Material for Casting Titanium

H. W. Antes, R. E. Edelman and J. T. Norton, Ordnance Corps, Frankfort Arsenal, Philadelphia

A Method of Casting Radiator-Type Fuel Elements for a Nuclear Reactor

A. W. Hare and R. F. Dickerson, Battelle Memorial Institute, Columbus, Ohio

Fundamental Papers

South Hall B, Auditorium

Ductile High Strength Titanium Castings by Induction Melting

J. Zotos, P. J. Ahearn and H. M. Green, Watertown Arsenal, Watertown, Mass.

Effect of Pressure During Solidification on Microporosity in Aluminum Alloys

S. Z. Uram, M. C. Flemings and H. F. Taylor, Massachusetts Institute of Technology, Cambridge, Mass.

Fundamental Studies on Effects of Solution Treatment, Iron Content and Chilling of Sand Cast Aluminum-Copper Alloy

E. M. Passmore, M. C. Flemings and H. F. Taylor, Massachusetts Institute of Technology, Cambridge, Mass.

Exhibits close

5:30 pm

International Reception

6:00 pm

Malleable Shop Course

Pine Room, Statler Hotel

8:00 pm

Melting Variables and Controls.

L. R. Jenkins, Wagner Malleable Iron Co., Decatur, Ill. Sponsored by AFS Controlled Melting Committee (6-F)

OFFICIAL PROGRAM, TUESDAY, MAY 20th

7:30 am Author — Chairman Breakfast

Ohio Room, Statler Hotel

8:30 am

Registration Opens

9:00 am Exhibits open



Dr. C. E. McQuiston

9:00 am

Pattern

Club Room C, Auditorium

A Little Knowledge of Plastics
R. LeMaster, Nelson Pattern Works, Milwaukee.

Construction Hints and Wear Characteristics of Plastic Patterns and Core Boxes
V. E. Zang, Unitcast Corp., Toledo, Ohio

Steel

Club Room B, Auditorium

The Effect of Vanadium on the Mechanical Properties of a 1% Chromium, 1% Molybdenum Cast Steel

R. S. Zeno and L. D. Tote, General Electric Co., Schenectady, N. Y.

Factors Influencing the Resistance of Steel Castings to High Stress Abrasion

T. E. Norman, Climax Molybdenum Co., Denver

Cast Age Hardening Austenitic Steel

E. A. Lange, N. C. Howelles, A. Bukowski, Naval Research Laboratory, Washington, D. C.

Light Metals

South Hall A, Auditorium

Effect of Impurities upon the Resistance of Magnesium Casting Alloys AM262 and AM266 to Corrosion

B. J. Nelson, Aluminum Co. of America, New Kensington, Pa.

Some Requirements for Successful Fluidity Testing

S. A. Prussin, Pacific Semiconductors, Inc., Culver City, Calif., and G. R. Fitterer, University of Pittsburgh, Pittsburgh, Pa.

An Improved Design for Cast Tensile Bar Molds

M. Karnowsky, Sandia Corp., Albuquerque, N. M.

Hearing and Radiation

Club Room A, Auditorium

Noise-Induced Hearing Loss
Eugene Walsh, M.D., International Harvester Co., Chicago

Radiation Protection Problems in Industry
A. F. Cota, A. O. Smith Corp., Milwaukee

Factors Influencing the Resistance of Steel Castings to High Stress Abrasion

T. E. Norman, Climax Molybdenum Co., Denver, Colo.

Dust Piping Modifications to Prevent Material Build-up and Wear

R. C. Orgies, American Air Filter Co., Louisville, Ky.



P. D. Green



G. S. Schaller

12:00 am

Malleable Round Table Luncheon

Pine Room, Statler Hotel

Diversification in the Malleable Industry
L. D. Ryan, Malleable Founders' Society, Cleveland

Pattern Round Table Luncheon

Oak Room, Carter Hotel

How Patternmakers Can Help to Sell Castings
G. K. Dreher, Steel Founders' Society, Cleveland

12:00 am AFS Board of Directors Luncheon and Business Meeting

Parlors 1 and 2, Statler Hotel

Fundamental Papers

South Hall B, Auditorium

Solidification and Riser of Gray Iron Castings

C. M. Adams, M. C. Flemings, and H. F. Taylor, Massachusetts Institute of Technology, Cambridge, Mass.

Resume of Formation of Ferrite and Pearlite in Cast Iron and Formation of Undercooled Graphite in Cast Iron

G. Ohira and K. Ikawa, Tohoku University, Sendai, Japan

Effect of Some Gases on the Work of Adhesion between a Novolak and Quartz

D. W. G. White, Dept. of Mines & Technical Surveys, Ottawa, Ont., and H. F. Taylor, Massachusetts Institute of Technology, Cambridge, Mass.

Effect of Temperature and Atmosphere on Iron-Silica Interface Reaction

G. A. Colligan, R. A. Flinn and L. H. Vanvack, University of Michigan, Ann Arbor

Reduction of Silica in Large Shell Molds

L. H. Vanvack, R. G. Wells and W. B. Pierce, University of Michigan, Ann Arbor

Light Metals

South Hall A, Auditorium

New Aluminum - Magnesium - Zinc Casting Alloy

H. C. Rutemiller, Aluminum Co. of America, Cleveland

High Strength Aluminum Alloy X357, Properties and Aging Practices

A. B. DeRoss, Kaiser Aluminum & Chemical Sales, Inc., Chicago

Foundry Practice for Sand Casting Commercially Pure Aluminum

M. V. Davis and R. V. Scalco, Anderson Electric Corp., Birmingham, Ala.

Tensile Properties of Microshrinkage - Graded AZ63 Magnesium Alloy

J. D. Grimsley and I. J. Feinberg, U. S. Naval Ordnance Laboratory, White Oak, Silver Spring, Md.

Sand

Club Room B, Auditorium

A Literature Survey of Metal Penetration

A. E. Murton and S. L. Gertsman, Dept. of Mines & Technical Surveys, Ottawa, Ont.

Mold Surface Behavior

D. Roberts, Oil City Iron Works, Corsicana, Texas, and E. E. Woodliff, Foundry Sand Service Engineering Co., Detroit

Sintered Alumina Molds for Investment Casting of Steels

B. Bovarnick, F. C. Quigley, Watertown Arsenal, Watertown, Mass.

Steel

Club Room A, Auditorium

Shell Molding for Steel Castings

R. G. Powell and H. F. Taylor, Massachusetts Institute of Technology, Cambridge, Mass.

Purchase Specifications for Steel Foundry Mold and Core Sand Binders

E. G. Vogel, Lebanon Steel Foundry, Lebanon, Pa.

2:30 pm



F. Dickerson



V. Howard

Malleable Shop Course

Pine Room, Statler Hotel

4:00 pm

The Supplemental Heat Treatment of Pearlitic Malleable Iron

Panel members:

Lead Pot Hardening — F. J. Asselin, Chevrolet Motor Div., G.M.C., Bay City, Mich;

Induction Hardening — A. Hoover, Oldsmobile Motor Div., G.M.C., Lansing, Mich;

Flame Hardening — A. C. Harris, Cincinnati Milling Machine Co., Cincinnati.

Hardenability of Pearlitic Malleable Iron Progress Report, AFS Pearlitic Malleable Committee (6-E)

R. W. Heine, University of Wisconsin, Madison

Motion Picture — "The Buhrer, Automated Molding and Pouring Method."

Comments by A. H. Homberger, American Automation Corp., New York

Exhibits close

5:00 pm

Sand Division Dinner

Euclid Ballroom, Hotel Statler

6:00 pm

Canadian Dinner

Cleveland Room, Hotel Cleveland

7:00 pm

Sand Shop Course

Pine Room, Hotel Statler

8:00 pm

Better Finish and More Accurate Dimensions through Good Sand Practice

V. Rowell, Harry W. Dietert Co., Detroit, with the following panel: Gray Iron — C. J. Jelinek, Ford Motor Co., Cleveland;

Steel — R. McCleery, National Malleable & Steel Castings Co., Sharon, Pa.; Malleable — C. E. Morrison, Dayton Malleable Iron Co., Ironton, Ohio; Light Metals — R. E. Daine, Aluminum Co. of America, Cleveland.

OFFICIAL PROGRAM, WEDNESDAY, MAY 21st

7:30 am Author — Chairman Breakfast Ohio Room, Statler Hotel

8:30 am Registration opens

Presiding — AFS President, Harry W. Dietert
President's Annual Address
Presentation of Awards of Scientific Merit
and AFS Service Citations
Apprentice Contest Awards
Election of Officers and Directors

9:30 am AFS Annual Business Meeting

10:30 am Charles Edgar Hoyt, Memorial Lecture

Silicon: Present and Future
W. E. Remmers, Union Carbide Corp., New York

11:00 am Exhibits open

Creating a Climate for Management Development
R. B. Parker, American Brake Shoe Co., New York

12:00 am Management Development Luncheon and Session Ohio Room, Statler Hotel

Getting the Most Out of Yourself
R. Monsalvatge, Dayton, Ohio

2:30 pm

Education Club Room A, Auditorium

Gray Iron South Hall B, Auditorium

Light Metals South Hall A, Auditorium



R. Strachan

Education And Our Industry's Survival
Panel members: G. K. Dreher, Steel Founders' Society of America; C. F. Walton, Gray Iron Founders' Society, Inc.; H. F. Scobie, Non-Ferrous Founders' Society; J. H. Lansing, Malleable Founders' Society; C. V. Nass, Beardsley & Piper Div., Pettibone Mulliken Corp., and E. J. Walsh, Foundry Educational Foundation

Motion Picture — Education And Our Industry's Survival
I. H. Dennen, Beardsley & Piper Div.

Sand

Club Room B, Auditorium

The Basic Concepts Committee
V. Rowell.

The Theoretical Concepts of the Packing of Small Particles

J. B. Caine, Consultant, Cincinnati, and C. E. McQuiston, Advance Foundry Co., Dayton, Ohio

A Study of the Ferritization of Nodular Iron
E. J. Eckel, University of Illinois, Urbana

Magnesium Content and Graphite Forms in Cast Iron

J. F. Ellis and C. K. Donoho, American Cast Iron Pipe Co., Birmingham, Ala.

Some Structural Considerations in Nodular Iron

V. Pulsifer, Armour Research Foundation, Chicago

Compaction Characteristics of Silica Sands
R. W. Heine, University of Wisconsin, Madison, and T. W. Seaton, American Silica Sand Co., Ottawa, Ill.

Packing Characteristics of Typical Foundry Sands

Induction Melting in a Magnesium Foundry
J. G. House and M. E. Brooks, The Dow Chemical Co., Bay City, Mich.

The Release of Hydrogen from Molten Aluminum

A. Pal, Annapurna Metal Works, Calcutta, India, and H. M. Davis, Pennsylvania State University, University Park, Pa.

Improvement of Castings by Press Forging

A. H. Murphy and W. Rostoker, Armour Research Foundation, Chicago, and L. L. Clark, Fansteel Metallurgical Corp., Muskogee, Okla.

L. J. Pedicini, Congress Die Casting Div., Tann Corp., Detroit

Sieve Ratios and Processing for Strong Molding Sands

J. T. Parisi, O. C. Nutter and C. Michalowski, Pekay Machine & Engineering Co., Chicago

4:00 pm

Plant & Plant Equipment Club Room C, Auditorium

Prevention by the Ounce
F. J. Dost and G. P. Ribar, Sterling Foundry Co., Wellington, Ohio

Establishing an Effective Preventive Maintenance Program

W. Huelsen, Caterpillar Tractor Co., Peoria, Ill.

5:00 pm Exhibits close

7:00 pm AFS Annual Banquet Ballroom, Statler Hotel

Presiding — AFS President Harry W. Dietert
Presentation of AFS Gold Medal Awards

Guest Speaker — Dr. Ralph E. Lapp, Director, Nuclear Science Service, Arlington,

Va.
Subject: Men, Rockets and Atoms.

OFFICIAL PROGRAM, THURSDAY, MAY 22nd

Author — Chairman Breakfast

Ohio Room, Statler Hotel

Registration opens

Exhibits open

7:30 am

8:30 am

9:00 am

Heat Transfer

Club Room C, Auditorium

Relationship of Interface Temperature and Solidification

V. Paschkis and J. W. Hlinka, Columbia University, New York

Ladle Heating in the Foundry

R. B. Renda, Purdue University, Lafayette, Ind., and W. M. Zeunik, National Malleable & Steel Castings Co., Indianapolis

Gray Iron

South Hall B, Auditorium

Gases in Cast Iron with Special Reference to Pickup of Hydrogen from Sand Molds

J. V. Dawson and L. W. L. Smith, British Case Iron Research Association, Birmingham, England. Presented by — H. E. Henderson, Lynchburg Foundry Co., Lynchburg, Va.

Automatic Ladling of Light Metals

Panel: R. C. Haverberg, A C Spark Plug Div. G.M.C., Flint, Mich.; C. H. George, Western Electric Co., Baltimore, Md.; H. Eriksen, Chrysler Corp., Kokomo, Ind.

Brass and Bronze

Club Room A, Auditorium

The Chemical Treatment of Copper Alloys

R. W. Ruddle, Foundry Services, Inc., Columbus, Ohio

Deoxidation Practice for Copper Shell-Molded Castings

R. C. Harris, Ordnance Corps, Frankford Arsenal, Philadelphia

Risening of Gray Iron Castings

J. F. Wallace and E. B. Evans, Case Institute of Technology, Cleveland. AFS RESEARCH Progress Report—Joint AFS—AWS Committee on Welding (5-N): Testing Methods & Procedures, B. F. Shepherd; Welding Gray Iron, S. Low; Welding Ductile Iron, W. Edens; Welding Malleable Iron, S. T. Walter

Investigations on the Effect of Heat on the Bonding Properties of Various Bentonites

Franz Hofmann, George Fischer, Ltd., Schaffhausen, Switzerland

The Problem of Hot Molding Sands

R. W. Heine, University of Wisconsin, Madison, E. H. King and J. S. Schumacher, Hill & Griffith Co., Cincinnati

Gas Pressures in Green Sand Molds

C. T. Marek, Purdue University, Lafayette, Ind., C. B. Ward, USAF, Materials Laboratory, Wright Air Development Center, Wright-Patterson AFB, Ohio



D. Fleming

Light Metals & Die Casting Round Table Luncheon Euclid Room, Statler Hotel

12:00

AFS Past Presidents' Luncheon

Parlor L, Statler Hotel

Brass & Bronze Seminar

Club Room A, Auditorium

What is Expected of a Casting

Panel: Casting Redesign — W. F. Straight, Bethlehem Steel Co., Quincy, Mass.; Casting Design — J. S. McVey, General Electric Co., Everett, Mass.; Casting Purchasing — J. W. Foster, Ingersoll-Rand Co., Phillipsburg, N. J.

Hot Deformation of Molding Sand

H. W. Dietert, Harry W. Dietert Co., Detroit, and T. E. Barlow, Eastern Clay Products Dept., International Minerals & Chemicals Corp., Chicago

Performance of Chills on High Strength Magnesium Alloy Sand Castings of Various Section Thickness

M. C. Flemings, R. W. Strachan, E. J. Poirier and H. F. Taylor, Massachusetts Institute of Technology, Cambridge, Mass.

Rigging Design of High Strength Magnesium Alloy Castings

M. C. Flemings, R. W. Strachan, E. J. Poirier and H. F. Taylor, Massachusetts Institute of Technology, Cambridge, Mass.

Industrial Engineering

Club Room C, Auditorium

An Approach to Work Simplifications

C. A. Hanson, Deere & Co., Moline, Ill.

Effort Rating — a Series of Effort Rating Films

J. Taylor, Norris & Elliott, Inc., Columbus, Ohio

Correlation of Green Strength, Dry Strength and Mold Hardness of Molding Sands

R. W. Heine, University of Wisconsin, Madison, E. H. King and J. S. Schumacher, Hill & Griffith Co., Cincinnati

of Technology, Cambridge, Mass.

The Effect of Cooling Rate on the Grain Size of Magnesium Casting Alloys

R. D. Green, The Dow Chemical Co., Midland, Mich.

The Parlanti Mold Process for the Casting of Metal by Controlled Rate of Heat Transfer

C. A. Parlanti and R. D. Veneklasen, Niforge Engineered Castings, Inc., Boston

Sand

Club Room B, Auditorium

Light Metals

South Hall A, Auditorium

Exhibits close

Gray Iron Shop Course

Euclid Room, Statler Hotel

Basic Microstructures

C. F. Walton, Gray Iron Founders' Society, Cleveland

2:30 pm

4:00 pm

5:30 pm

8:00 pm

OFFICIAL PROGRAM, FRIDAY, MAY 23rd

7:30 am Author — Chairman Breakfast Ohio Room, Statler Hotel

8:30 am Registration opens

9:00 am Exhibits open

9:00 am **Heat Transfer Clinic**
Club Room C, Auditorium

Brass & Bronze
Club Room A, Auditorium

Gray Iron
South Hall B, Auditorium



M. Flemings

Heat Transfer in the Foundry — Question and Answer Session

Panel: V. Paschkis, Heat & Mass Flow Analyzer Laboratory, Columbia University, New York; J. B. Caine, Consultant, Cincinnati; W. E. Sicha, Aluminum Co. of America, Cleveland; C. K. Donoho, American Cast Iron Pipe Co., Birmingham, Ala.; and R. C. Shnay, Canada Iron Foundries, Ltd., Toronto, Ont.

Die Casting

South Hall A, Auditorium

Die and Permanent Mold Casting of Non-Ferrous Metals in the United Kingdom

L. J. Brice and G. A. Broughton, Ministry of Supply, England

Brass & Bronze Research Report — "Effects of Foundry Variables upon Porosity of BS-5-5-5 Bronze"

R. A. Flinn and C. R. Mielke, University of Michigan, Ann Arbor

Occurrence and Elimination of Leakage in a Gun Metal Casting

M. Glassenberg, Armour Research Foundation, Chicago; A. H. Hesse, R. Lavin & Sons, Inc., Chicago; and W. H. Baer, Bureau of Ships, Navy Department, Washington, D.C.

The Use of Oil-Bentonite Sand for Higher Quality Finish in Brass and Bronze Castings

O. E. Johnson, H. B. Ives Co., New Haven, Conn.

The Controlled — Slag Hot Blast Cupola

D. Fleming, Foundry Consultant to the Textile Machinery Makers Ltd., England. Officially sponsored by The Institute of British Foundrymen, Deansgate, Manchester, England. Presented by R. W. Kraft, University of Michigan, Ann Arbor

Foundry Applications of the Calcium Carbide Injection Process

W. R. Lysobey and A. E. Tull, Air Reduction Sales Co., New York

Effect of Size of Scrap on the Tapping Temperature of the Cupola

N. H. Keyser and W. L. Kann, Jr., Battelle Memorial Institute, Columbus, Ohio

12:00 am **Brass & Bronze Round Table Luncheon** Ohio Room, Statler Hotel

Gray and Ductile Iron Round Table Luncheon Pine Room, Statler Hotel

Duplexing Pays at Pontiac Foundry
H. A. Laboret, Pontiac Motor Co., Pontiac, Mich., and F. J. Webbere, Research Staff, G.M.C., Detroit

Aluminum Melting Practice for Die Casting and Permanent Molding
J. P. Moehling, Stromen Furnace & Engineering Co., Franklin Park, Ill.

New Developments in Copper-Base Alloy Casting Methods

Sand Molding — V. M. Rowell, American Brake Shoe Co.; **Permanent Molding** — N. Birch, American Brake Shoe Co., St. Louis; **Centrifugal Casting** — Nathan Janco, Centrifugal Casting Machine Co., Tulsa, Okla.

2:30 pm **Gray Iron Shop Course** South Hall B, Auditorium **Industrial Engineering** Club Room C, Auditorium **Sand** Club Room B, Auditorium

Relation of Mechanical Properties to Microstructures
S. C. Massari, American Foundrymen's Society, Des Plaines, Ill.

Practical Application of the Work Sampling Technique

J. N. Capretta and R. M. Keenan, International Harvester Co., Chicago

Introduction to Work Sampling — Motion picture

University of California, Berkeley

Industrial Application of Olivine Aggregate
G. S. Schaller, University of Washington, Seattle

Evaluation of Shell Molding Capability

W. C. Truckenmiller, C. R. Baker and G. H. Bascom, Albion Malleable Iron Co., Albion, Mich.

Report of Shell Molding Survey

N. Sheptak, Dow Chemical Co., Midland, Mich. — Report of AFS Sand Division Committee 8-N

High Temperature Properties of Shell Molds

R. A. Rabe, Foundry Process Development Section, G.M.C., Detroit — Report of AFS Sand Division Committee 8-N

Die Casting

South Hall A, Auditorium

Melting Practice for Aluminum Casting Alloys
W. N. Brammer, Apex Smelting Co., Cleveland

Progress in Vacuum Die Casting

D. Morgenstern, Nelmore Mfg. Corp., Euclid, Ohio

Experiences in Non-Ferrous Die Casting Die and Permanent Mold Life

G. Otto, Maytag Co., Newton, Iowa

5:00 pm Exhibits close 62d AFS Castings Congress and Foundry Show officially closes

OFFICIAL GUIDE TO EXHIBITS

WITH FLOOR PLAN

Acme Resin Corp., Forest Park, Ill. Shell molding materials and equipment. **Booth No. 1751**

Adams Co., Dubuque, Iowa. Flasks and accessories, molding machines, vibrators. **Booth No. 621**

A.I.C. Engineering Co., Indianapolis. Blast cleaning equipment and accessories, cleaning and finishing equipment and accessories, engineering services, material handling equipment and accessories, noise and shock absorption materials, shakeout equipment and accessories. **Booth No. 124-B**

Air Reduction Co., New York. CO₂ equipment and supplies, fluxes, welding and cutting equipment and accessories. **Booth No. 319-A**

Ajax Electrothermic Corp., Trenton, N. J. Heat treating furnaces, melting furnaces. **Booth No. 1392**

Ajax Engineering Corp., Trenton, N. J. Melting furnaces. **Booth No. 1306**

Ajax Metal Div., H. Kramer & Co., Philadelphia, Chicago, & El Segundo, Calif. Non-ferrous alloys, copper-base ingots. **Booth No. 1310**

Ajem Laboratories, Inc., Livonia, Mich. Air pollution control equipment, cleaning and finishing equipment and accessories, dust control equipment and accessories, engineering services, chemicals for air pollution control. **Booth No. 2018**

Allied Chemical & Dye Corp., See Smet Solvay Div.

Alloy Metal Abrasive Co., Ann Arbor, Mich. Abrasives for blasting and grinding. **Booth No. 910**

Alloy Metal Products, Inc., Davenport, Iowa. Ferrous and nonferrous alloys. **Booth No. 404**

Alphaco, Inc., York, Pa. CO₂ Equipment and supplies. **Booth No. 324**

Alpha-Lux Co., New York. Refractories, moisture tester, riser covering materials. **Booth No. 1112**

Aluminum Co. of America, Pittsburgh, Pa. **Booth No. 415**

American Air Filter Co., Louisville, Ky. Dust control equipment and accessories. **Booths No. 907-909**

American Alloys Corp., Kansas City, Mo. Alloys and aluminum ingots. **Booth No. 1402**

American Automation Corp., Ann Arbor, Mich. Engineering services. **Booth No. 1848**

American Chain & Cable Co., Bridgeport, Conn. Foundry supplies, material handling equipment and accessories, shakeout equipment and accessories. **Booth No. 115**

American Colloid Co., Skokie, Ill. Clay, core binders, facings, fire brick and clay, foundry supplies, sand. **Booth No. 1117**

American Fire Clay & Products Co., Brighton Brick Co., Canfield, Ohio. Clay, core and mold washes, fire brick and clay, fire clay products, mold and core washes. **Booth No. 101**

American Foundry Flask Co., Kansas City, Mo. Flasks and accessories. **Booth No. 813**

American Marietta Co., See Hydro-Blast Div.

American Gas Association, New York. Gas service information center. **Booth No. 514**

American Metal Market, New York. Daily newspaper. **Booth No. 1517**

American Refractories & Crucible Corp., North Haven, Conn. Crucibles, graphite products, insulating materials, refractories. **Booth No. 418**

American Smelting & Refining Co., See Federated Metals Div.

American Society for Metals, Cleveland. Educational service. **Booth No. 407**

American Steel Abrasives Co., See Pittsburgh Crushed Steel Co.

Apex Smelting Co., Chicago. Non-ferrous alloys, fluxes, and aluminum ingots. **Booth No. 214**

Applied Research Laboratories, Glendale, Calif. Laboratory and scientific equipment. **Booth No. 121**

Arcair Co., Lancaster, Ohio. Electrodes, welding and cutting equipment and accessories. **Booth No. 1108**

Archer-Daniels-Midland Co., Federal Foundry Supply Div., Cleveland, Clay, CO₂ equipment and supplies, core and mold washes, core binders, core oils, coremaking equipment and accessories, facings, foundry supplies, graphite products, mold and core washes, molding machines, sand handling and conditioning, sand reclamation equipment, shell molding materials and equipment. **Booths No. 908-1008, 1109-1111**

Arrowhead Co., See Manley Bros.

Barold Division, National Lead Co., Chicago. Core binders, fire brick and clay. **Booth No. 414**

C. O. Bartlett & Snow Co., Cleveland. Air pollution control equipment, briquetting equipment, cleaning and finishing equipment and accessories, conveying equipment and accessories, cranes and hoists, cupolas and accessories, dust control equipment and accessories, engineering services, heating and ventilating equipment and accessories, hoists and cranes, ladles, material handling equipment and accessories, sand handling and conditioning equipment and accessories, sand reclamation equipment, shakeout equipment and accessories, shell molding materials and equipment. **Booths No. 2134-2136**

Beardsley & Piper Div., Pettibone Mulliken Corp., Chicago. Conveying equipment and accessories, coremaking equipment and accessories, electrical equipment and controls, laboratory and scientific equipment, material handling equipment and accessories, molding machines, sand handling and conditioning equipment and accessories, sand reclamation equipment, shakeout equipment and accessories, shell molding and equipment, trucks and tractors. **Booths No. 1552-62, 1653-63**

Blasterete Service Co., Los Angeles. Refractories. **Booth No. 614**

Blaw-Knox Co., Blaw-Knox Equipment Div., Pittsburgh, Pa. Hoists. **Booth No. 323**

Bradley Washfountain Co., Milwaukee. Washroom equipment and supplies. **Booth No. 2207**

Brighton Brick Co., See American Fire Clay & Products Co.

British Industries Corp., See Shaw Process Development Corp.

British Moulding Machine Co. Ltd., Faversham, Kent, England. Molding machines. **Booths No. 1817-19**

Brown Co., Boston. Safety clothing, equipment, washroom equipment and supplies. **Booth No. 207**

Brown Thermal Development Co., Elvira, Ohio. Cupolas and accessories. **Booth No. 1662**

Brush Beryllium Co., Cleveland. Non-ferrous alloys, copper-base ingots. **Booth No. 124**

Burr Aluminum Products, Burr Oak, Mich. Coremaking equipment and accessories, flasks and accessories, material handling equipment and accessories. **Booth No. 507**

C & S Products Co., Detroit. Blowers, conveying equipment and accessories, coremaking equipment and accessories, engineering services, material handling

equipment and accessories, molding machines, patterns, sand handling and conditioning equipment and accessories, shell molding materials and equipment. **Booths No. 1838-1840, 1937-1943**

Campbell-Hausfeld Co., Harrison, Ohio. Non-ferrous melting furnaces. **Booth No. 1658**

Carborundum Co., Electro Minerals Div., Niagara Falls, N. Y. Ferrocarril briquettes and grain. **Booth No. 518**

Carrier Conveyor Corp., Louisville, Ky. Conveying equipment and accessories, engineering services, material handling equipment and accessories, sand handling and conditioning equipment and accessories. **Booths No. 2133-2135**

Carver Foundry Products, Muscatine, Iowa. Blowers, CO₂ equipment and supplies, core and mold washes, core binders, coremaking equipment and accessories, facings, laboratory and scientific equipment, mold and core washes, molding machines, pattern shop equipment and supplies, sand reclamation equipment. **Booths No. 1405-1409**

Centrifugal Casting Machine Co., Tulsa, Okla. Centrifugal casting equipment. **Booth No. 307**

Centri-Spray Corp., Livonia, Mich. Air pollution control equipment, cleaning and finishing equipment and accessories, conveying equipment and accessories, dust control equipment and accessories, engineering services, material handling equipment and accessories, non-destructive testing equipment. **Booth No. 2018**

Clayton-Sherman Abrasives Co., See Pittsburgh Crushed Steel Co.

Clearfield Machine Co., Clearfield, Pa. Sand handling and conditioning equipment and accessories. **Booth No. 502**

Cleveland Flux Co., Cleveland. Fluxes. **Booths No. 218, 315**

Cleveland Metal Abrasive Co., Cleveland. Abrasives. **Booth No. 1518**

Deveon Corp., Danvers, Mass. Coremaking equipment and accessories, foundry supplies, matchplates and patterns, pattern shop equipment and supplies, shell molding materials and equipment. **Booth No. 109**

Cleveland Vibrator Co., Cleveland. Conveying equipment and accessories, lubricating materials and equipment, portable tools, sand handling and con-

ditioning, shakeout equipment and accessories, vibrators. **Booth No. 2013**

Continental Copper & Steel Industries, Inc., See Niagara Falls Smelting & Refining Div.

Continental Silica Co., Somonauk, Ill. Silica sand. **Booth No. 1712**

Corn Products Sales Co., New York. Core binders. **Booth No. 114**

Davey Compressor Co., Kent, Ohio. Air compressors and accessories. **Booth No. 2045**

Davis Fire Brick Co., Columbus, Ohio. Clay, fire brick and clay, fire clay products, refractories. **Booth No. 209**

Dayton Oil Co., Dayton, Ohio. Core and mold washes, core binders, core oils, mold and core washes. **Booth No. 505**

Delhi Foundry Sand Co., Cincinnati. CO₂ equipment and supplies, fluxes, foundry supplies, ladles, sand. **Booth No. 605**

Delta Oil Products Corp., Milwaukee. CO₂ equipment and supplies, core and mold washes, core binders, core oils, facings, lubricating materials and equipment, mold and core washes. **Booth No. 605**

Demmler Mfg. Co., Kewanee, Ill. CO₂ equipment and supplies, coremaking equipment and accessories. **Booth No. 2140**

Dependable Pattern Works, Portland, Ore. Coremaking equipment and accessories, shell molding materials and equipment. **Booth No. 1010**

Detroit Electric Furnace Div., Kuhlman Electric Co., Bay City, Mich. Ferrous and non-ferrous melting furnaces. **Booth No. 1124**

Diamond Alkali Co., Cleveland. CO₂ equipment and supplies, coke, core binders, engineering services, fluxes. **Booth No. 421**

Harry W. Dietert Co., Detroit. Laboratory and scientific equipment, sand handling and conditioning equipment and accessories. **Booths No. 1841-1843**

Dike-O-Seal, Inc., Chicago. Coremaking equipment and accessories. **Booth No. 1021**

Joseph Dixon Crucible Co., Jersey City, N. J. Crucibles, graphite products, insulating materials, refractories. **Booth No. 805**

Durez Plastics Div., Hooker Electrochemical Co., Tonawanda, N. Y. Shell molding materials and equipment. **Booth No. 613**

GUIDE TO EXHIBITS

Eastern Clay Products Dept., International Minerals & Chemicals Corp., Chicago. Air compressors and accessories, clay, CO₂ equipment and supplies, core binders, cupolas and accessories, facings, fire brick and clay, mold and core washes, molding machines, portable tools, refractories, shell molding materials and equipment.

Booths No. 911, 913, 919

Electric Controller & Mfg. Div. See Square D Co.

Electro Metallurgical Co., Div. Union Carbide Corp., New York. Ferroalloys and metals, ferroalloy briquets.

Booths No. 1301-09, 1313-17

Electro Minerals Div. See Carborundum Co.

Electro Refractories & Abrasives Corp., Buffalo, N. Y. Abrasives, crucibles, grinding equipment and accessories, refractories.

Booth No. 718

Encyclopedia Britannica, Inc., Detroit. Exhibiting encyclopedia.

Booth No. 706

Eutech Welding Alloys Corp., Flushing, N. Y. Electrodes, fluxes, welding and cutting equipment and accessories.

Booths No. 396, 403

Exomet, Inc., Conneaut, Ohio. Ferrous and non-ferrous alloys, fluxes, aluminum ingots, welding and cutting equipment and accessories.

Booth No. 808

F. E. (North America) Ltd., Leighton Buzzard, England. Conveying equipment and accessories, coremaking equipment and accessories, engineering services, material handling equipment and accessories, molding machines, sand handling and conditioning equipment and accessories, sand reclamation equipment, shakeout equipment and accessories, shell molding materials and equipment.

Booths No. 2046-52, 2143-47

Fanner Mfg. Co., Cleveland. Chaplets and nails.

Booth No. 1408

Federal Foundry Supply Div. See Archer-Daniels-Midland Co.

Federated Metals Div., American Smelting & Refining Co., New York. Non-ferrous alloys, aluminum and copper-base ingots.

Booth No. 721

Flick-Reedy Corp., Miller Fluid Power Div., Melrose Park, Ill. Hydraulic and pneumatic operating cylinders.

Booth No. 1549

Foundry Magazine, See Penton Publishing Co.

Foundry Educational Foundation, Cleveland. Organization for encouragement of foundry education at college level.

Booth No. 1824

Foundry Equipment Co., Cleveland. Core and mold ovens, heat treating furnaces, mold ovens and dryers, core ovens.

Booths No. 2019-21

Foundry Equipment Manufacturers Association, Washington, D. C.

Booths No. 1717-19

Foundry Flask & Equipment Co., Northville, Mich. Flasks and accessories.

Booth No. 2219

Foundry Services, Inc., Columbus, Ohio. CO₂ equipment and supplies, core and mold washes, fluxes, mold and core washes.

Booths No. 2102, 2206

Fox Grinders, Inc., Pittsburgh, Pa. Abrasives, grinding equipment and accessories.

Booth No. 1121

Freeman Supply Co., Toledo, Ohio. Pattern shop equipment and supplies, woodworking, machinery and accessories.

Booths No. 1621-1629

Fremont Flask Co., Fremont, Ohio. Flasks and accessories.

Booth No. 612

Fritz Hansberg Co. of America, Chicago. CO₂ equipment, molding machines, coremaking, shell molding.

Booth No. 2108

Furane Plastics, Inc., Los Angeles. Matchplates and patterns, pattern shop equipment and supplies, plastic patterns.

Booth No. 721

Galland-Henning Mfg. Co., Nopak Div., Milwaukee. Cupolas and accessories, pneumatic equipment and controls, air and hydraulic cylinders, air control valves.

Booth No. 2213

General Dynamics Corp. See Liquid Carbonic Div.

General Refractories Co., Philadelphia. Fire brick and clay, fire clay products, insulating materials, refractories.

Booth No. 107

Girdler Co., Theumex Div., Louisville, Ky. Dielectric ovens.

Booths No. 2121-23

Globe Steel Abrasive Co., See Pittsburgh Crushed Steel Co.

Glover Mfg. Co., Meadville, Pa. Coremaking equipment and accessories, pattern shop equipment and supplies, woodworking machinery and accessories.

Booth No. 118-A

Daniel Goff Co., Jesse S. Morie & Son, Inc., Mauricetown, N. J. Abrasives, clay, fire clay products, sand.

Booth No. 112

Gray Iron Founders' Society, Cleveland. National trade association for gray iron foundry industry.

Booths No. 1618-20

Great Lakes Carbon Corp., New York. Coke, crucibles, electrodes graphite products, refractories.

Booth No. 401

Great Lakes Foundry Sand Co., Detroit. Clay, CO₂ equipment and supplies, coke, sand, shell molding materials and equipment.

Booth No. 322

Samuel Greenfield Co., Buffalo, N. Y. Non-ferrous alloys, aluminum and copper-base ingots.

Booth No. 428

Greenlee Bros. & Co., Rockford, Ill. Coremaking equipment and accessories.

Booth No. 1711

Guardite Co., Div. of American Marietta Co. See Hydro-Blast Div.

Harblson-Walker Refractories Co., Pittsburgh, Pa. Clay, fire brick and clay, foundry supplies, refractories, shell molding materials and equipment.

Booth No. 305

Hardy Sand Co., Evansville, Ind. Sand.

Booth No. 818

Benj. Harris & Co., Chicago Heights, Ill. Non-ferrous alloys, copper-base ingots.

Booth No. 509

Harrison Machine Co., Westleyville, Erie, Pa. Coremaking equipment and accessories, shell molding materials and equipment.

Booth No. 2243

Hartley Controls Corp., Neenah, Wis. Electrical equipment and controls, sand handling and conditioning equipment and accessories.

Booth No. 2237

Herman Pneumatic Machine Co., Pittsburgh, Pa. Centrifugal casting equipment, molding machines.

Booths No. 2117-2119

Hickman, Williams & Co., Cleveland. Abrasives, ferrous alloys, clay, CO₂ equipment and supplies, coke, fire brick and clay, fire clay products, flasks and accessories, fluxes, molding machines, pig iron, refractories, sand.

Booth No. 215

High Sierra Pine Mills, Inc., Oroville, Calif. Pattern shop equipment and supplies.

Booth No. 1824

Hill & Griffith Co., Cincinnati. CO₂ equipment and supplies, core and mold washes, core binders, foundry supplies, graphite products, mold and core washes.

Booths No. 1531-33

Hines Flask Co., Cleveland. Flasks and accessories.

Booth No. 606

Hooker Electrochemical Co. See Durez Plastics Div.

Horne & Associates. See High Sierra Pine Mills, Inc.

Frank G. Hough Co., Libertyville, Ill. Material handling equipment and accessories, sand handling and conditioning equipment and accessories.

Booths No. 1534-1542

Houghton Laboratories, Inc., Olean, N. Y. Matchplates and patterns, pattern shop equipment and supplies.

Booth No. 221

Hutchinson Shell Mold Co., Alton, Ill. Metal patterns, shell molding materials and equipment.

Booth No. 1649

Hydro-Blast Div., American-Marietta Co., Wheeling, Ill. Blast cleaning equipment and accessories, coremaking equipment and accessories, sand reclamation equipment, shell molding materials and equipment.

Booth No. 2217

Illinois Clay Products Co., Chicago. Clay, fire brick and clay, graphite products, insulating materials, refractories, sand handling and conditioning equipment and accessories.

Booth No. 807

Illinois Testing Laboratories, Inc., Chicago. Heating and ventilating equipment and accessories, laboratory and scientific equipment, pyrometers, temperature control and recording devices, ventilating and heating equipment and accessories.

Booth No. 110

Indianapolis Wire Bound Box Co., Fernwood, Miss. Pallets and shipping containers.

Booth No. 1541

Inductotherm Corp., Delanco, N. J. Heat treating furnaces, ferrous and non-ferrous melting furnaces.

Booth No. 1830

Industrial Electronics Dept. See Westinghouse Electric Corp.

International Foundry Supply Co., Reading, Pa. CO₂ equipment and supplies, core binders, coremaking equipment and accessories, fluxes, ferrous and non-ferrous melting furnaces, pattern shop equipment and supplies.

Booths No. 1727-1729

International Minerals & Chemicals Corp. See Eastern Clay Products Dept.

International Molding Machine Co., LaGrange Park, Ill. CO₂ equipment and supplies, coremaking equipment and accessories, engineering services, molding machines, vibrators.

Booths No. 1418-20, 1535-37

International Nickel Co., New York. Ferrous and non-ferrous alloys, electrodes, engineering services, welding and cutting equipment and accessories.

Booths No. 106-108, 203-205

Interstate Smelting & Refining Co., Chicago. Ingots Copper-base.

Booth No. 412

Iron Lung Ventilator Co., Cleveland. Ventilating and heating equipment and accessories.

Booths No. 1114, 1118

Jeffrey Manufacturing Co., Columbus, Ohio. Briquetting equipment, conveying equipment and accessories, engineering services, flexible couplings, material handling equipment and accessories, sand handling and conditioning equipment and accessories, sand reclamation equipment, shakeout equipment and accessories.

Booths No. 2036-2038

Kaiser Aluminum & Chemical Sales, Inc., Chicago. Non-ferrous alloys, aluminum ingots.

Booth No. 920

Keystone Refractories Co., New York. Refractory lining materials.

Booth No. 419

Kindt-Collins Co., Cleveland. Dust control equipment and accessories, pattern shop equipment and supplies, woodworking machinery and accessories.

Booths No. 2040, 2137

King Tester Corp., Philadelphia. Physical testing equipment.

Booth No. 208

Lester B. Knight & Associates, Inc., Chicago. Engineering services.

Booth No. 2634

H. Kramer & Co., See Ajax Metal Div. Kuhlman Electric Co. See Detroit Electric Furnace Div.

Laboratory Equipment Corp., St. Joseph, Mich. Heat treating furnaces, laboratory and scientific equipment.

Booth No. 2245

Latrobe Steel Co., Latrobe, Pa. Blast cleaning equipment and accessories, sand handling and conditioning equipment and accessories, sand reclamation equipment.

Booth No. 2118

Lava Crucible Refractories Co., Pittsburgh, Pa. Core and mold washes, crucibles, mold and core washes, refractories.

Booth No. 611

R. Lavin & Sons, Inc., Chicago. Non-ferrous alloys, aluminum and copper-base ingots.

Booth No. 1951

Lectromelt Furnace Div., McGraw-Edison Co., Pittsburgh, Pa. Furnaces, ferrous melting furnaces.

Booths No. 914, 1017

Lindberg Engineering Co., Chicago. Non-ferrous melting furnaces.

Booths No. 1404-1406, 1521-1523

Linde Co., Div. Union Carbide Corp., New York. Injection equipment and supplies, copper-base ingots.

Booths No. 1301-13

Link-Belt Co., Chicago. Conveying equipment and accessories, engineering services, flexible couplings, material handling equipment and accessories, sand handling and conditioning, sand reclamation equipment, shakeout equipment and accessories, shell molding materials and equipment, vibrators.

Booths No. 1635-45

Liquid Carbonic Div., General Dynamics Corp., Chicago. CO₂ equipment and supplies, coremaking equipment and accessories.

Booths No. 1525-1527

Lowery Bros., Inc., Chicago. Wire rope cables and slings.

Booth No. 1110

Magnaflex Corp., Chicago. Non-destructive testing equipment.

Booth No. 513

Magnet Cove Barium Corp., Des Plaines, Ill. Clay.

Booth No. 1526

Manley Bros., Lyle T. Manley Co., Arrowhead Co., Chesterton, Ind. Sand.

Booth No. 501

Manley Sand Co., Rockton, Ill. Sand.

Booth No. 102

Martin Engineering Co., Neponset, Ill. Coremaking equipment and accessories, pattern shop equipment and supplies, vibrators.

Booth No. 311

Master Pneumatic Tool Co., Bedford, Ohio. Hoists and cranes, portable tools.

Booths No. 1628-1630

Carl Mayer Corp., Cleveland. Core and mold ovens, heat treating furnaces, heating and ventilating equipment and accessories, mold ovens and dryers, core and mold ovens, ventilating and heating equipment and accessories.

Booth No. 411

J. S. McCormick Co., Pittsburgh, Pa. Core and mold washes, core binders, core oils, facings, foundry supplies, mold and core washes.

Booth No. 1617

McGraw-Edison Co. See Lectromelt Furnace Div.

Miller Fluid Power Div. See Flick-Reedy Corp.

Mine Safety Appliances Co., Pittsburgh, Pa. Safety clothing, equipment.

Booth No. 714

Modern Castings, Des Plaines, Ill. Monthly magazine of the metal castings industry.

Booths No. 206, 303

Modern Equipment Co., Port Washington, Wis. Cupolas and accessories, ladles, material handling equipment and accessories.

Booths No. 1622-24, 1721-23

Monsanto Chemical Co., Plastics Div., St. Louis. Core binders, shell molding materials and equipment.

Booth No. 1548

Jesse S. Morie & Son, Inc. See Daniel Goff Co.

Moulders' Friend, Dallas City, Ill. Sand handling and conditioning equipment and accessories. **Booth No. 2053**

Nassau Smelting & Refining Co., Totenville, S.I., N.Y. Ingots. **Booth No. 118**

National Air Conveyor Corp., Chicago. Pneumatic sand handling systems. **Booth No. 2218**

National Carbon Co., Div. Union Carbide Corp., New York. Crucibles, electrodes, graphite products, refractories (brick, linings), welding and cutting equipment and accessories. **Booths No. 1301-1309, 1313-17**

National Crucible Co., Philadelphia. Crucibles, graphite products, mold and core washes, refractories. **Booth No. 712**

National Cylinder Gas Co., Chicago. Industrial gases. **Booth No. 2129**

National Dust Collector Corp., Chicago. Dust collectors. **Booth 2220**

National Engineering Co., Chicago. Air pollution control equipment, CO₂ equipment and supplies, conveying equipment and accessories, coremaking equipment and accessories, dust control equipment and accessories, material handling equipment and accessories, sand handling and conditioning equipment and accessories, shell molding materials and equipment. **Booths No. 105-106-1314, 2208-2212, 2218-2220**

National Foundry Sand Co., Detroit. Fire clay products, foundry supplies, material handling equipment and accessories, refractories. **Booth No. 210**

National Lead Co. See Baroid Div.

National Metal Abrasive Co., Cleveland. Shot for abrasive cleaning. **Booth No. 219**

National Safety Council, Chicago. Training aids and technical publications for industrial safety programs. **Booth No. 1818**

New Jersey Silica Sand Co., Millville, N. J. CO₂ equipment and supplies, fire clay products, sand, shell molding materials and equipment. **Booth No. 308**

Newaygo Engineering Co., Newaygo, Mich. Conveying equipment and accessories, flasks and accessories, sand handling and conditioning equipment and accessories. **Booths No. 1642-1644, 1741-1743**

Niagara Falls Smelting & Refining Div., Continental Copper & Steel Industries, Inc., Buffalo, N. Y. Non-ferrous alloys, fluxes, aluminum and copper-base ingots. **Booth No. 507-A**

Wm. H. Nicholls Co., Richmond Hill, N. Y. Molding machines. **Booth No. 1403**

Nolan Machinery Co., Div. United States Forge & Foundry Co., Pulaski, N. Y. CO₂ equipment and supplies, coremaking equipment and accessories, laboratory and scientific equipment, sand handling and conditioning equipment and accessories. **Booth No. 410**

Non-Ferrous Founders' Society, Chicago. National organization of copper, aluminum and magnesium-base foundries. **Booth No. 812**

North American Smelting Co., Wilmington, Dela. Non-ferrous alloys, aluminum and copper-base ingots. **Booth No. 903**

North State Pyrophyllite Co., Greensboro, N. C. Cupolas and accessories, fire brick and clay, fire clay products, ferrous melting furnaces, refractories. **Booth No. 409**

S. Obermayer Co., Chicago. Core and mold washes, core binders, facings, fire brick and clay, mold and core washes. **Booth No. 617**

Ohio Crankshaft Co. See Tocco Div.

Ohio Ferro-Alloy Corp., Canton, Ohio. Ferrous and non-ferrous alloys. **Booth No. 312**

Olin Mathieson Chemical Corp., Olin

Aluminum Div., New York. Non-ferrous CO₂ equipment and supplies, ingots. **Booth No. 705**

Oliver Machinery Co., Grand Rapids, Mich. Pattern shop equipment and supplies, woodworking machinery and accessories. **Booths No. 618, 717**

Orefraction, Inc., Pittsburgh, Pa. Sand. **Booth No. 512**

Osborn Mfg. Co., Cleveland. Blowers, coremaking equipment and accessories, electrical equipment and controls, molding machines, shell molding materials and equipment, vibrators. **Booths No. 1632-1638, 1731-1737**

Pangborn Corp., Hagerstown, Md. Abrasives, blast cleaning equipment and accessories, cleaning and finishing equipment and accessories, dust control equipment and accessories, safety clothing, equipment. **Booths No. 2033-2043**

Pekay Machine & Engineering Co., Chicago. Engineering services, material handling equipment and accessories, sand handling and conditioning equipment and accessories. **Booths No. 1718-1720**

Penn-Rilliton Co., New York. Core binders, facings. **Booth No. 1318**

Penola Oil Co., Detroit. Core binders, core oils. **Booth No. 1020**

Penton Publishing Co., Foundry Magazine, Cleveland. Publications. **Booth No. 1530**

Pettibone Mulliken Corp. See Beardsley & Piper Div.

George F. Pettinos, Inc., Philadelphia. Abrasives, core and mold washes, core binders, facings, foundry supplies, granite products, insulating materials, mold and core washes, sand. **Booths No. 902-904, 1001-1003**

Picker X-Ray Corp., White Plains, N. Y. Laboratory and scientific equipment, non-destructive testing equipment, x-ray and radium. **Booth No. 804**

Pittsburgh Crushed Steel Co., Pittsburgh, Pa. **Globe Steel Abrasive Div.**, Mansfield, Ohio, **Amerleann Steel Abrasives Co.**, Gallon, Ohio, **Clayton-Sherman Abrasive Div.**, Detroit, **Steel Shot & Grit Co.**, Boston. Abrasives, blast cleaning and finishing equipment and accessories, foundry supplies, shell molding materials and equipment. **Booth No. 607**

P M S Co., Cleveland. Pattern shop equipment and supplies, woodworking machinery and accessories. **Booth No. 1021**

Products Engineering Co., Cape Girardeau, Mo. Flasks and accessories. **Booth No. 415-A**

Pure Carbonic Co. See Air Reduction Co.

Pyrometer Instrument Co., Bergenfield, N. J. Laboratory and scientific equipment, pyrometers, temperature control and recording devices. **Booth No. 711**

Redford Iron & Equipment Co., Detroit. CO₂ equipment and supplies, coremaking equipment and accessories. **Booths No. 1722-1724**

H. B. Reed & Co., Hammond, Ind. Abrasives. **Booth No. 420**

Rezolla, Inc., Santa Monica, Calif. Pattern shop equipment and supplies. **Booth No. 814**

H. H. Robertson Co., Pittsburgh, Pa. Ventilating and heating equipment and accessories. **Booth No. 212**

Roessing Bronze Co., Pittsburgh, Pa. Non-ferrous alloys, aluminum and copper-base ingots. **Booth No. 125**

Ross Operating Valve Co., Detroit. Pneumatic valves. **Booth No. 517**

Ross-Tacony Crucible Co., Philadelphia. Crucibles, graphite products, refracto-

ries.

Royer Foundry & Machine Co., Kingston, Pa. Sand handling and conditioning equipment and accessories, shakeout equipment and accessories. **Booths No. 2220-2235**

Sand Products Corp., Cleveland. Sand. **Booth No. 706-A**

Claude B. Schnelble Co., Detroit. Air pollution control equipment, dust control equipment and accessories, heating and ventilating equipment and accessories, ventilating and heating equipment and accessories. **Booths No. 2120-2122**

A. Schrader's Son, Div. Scoville Mfg. Co., Brooklyn, N. Y. Air compressors and accessories. **Booth No. 1742-1744**

Schramm, Inc., West Chester, Pa. Air compressors and accessories. **Booths No. 1851-1852**

I. Schumann & Co., Cleveland. Non-ferrous Alloys, and copper-base ingots. **Booth 820**

Scientific Cast Products Corp., Cleveland. Matchplates and patterns. **Booth No. 310**

Scoville Mfg. Co. See A. Schrader's Son, Brooklyn.

Semet-Solvay Div., Allied Chemical & Dye Corp., New York. Coke. **Booth No. 708**

Shaleo Corp., Palo Alto, Calif. Blowers, coremaking equipment and accessories, molding machines, shell molding materials and equipment. **Booths No. 1917-1919**

Shaw Process Development Corp., Div. British Industries Corp., Port Washington, N. Y. Shaw process. **Booth No. 405**

Shell Process, Inc., West Springfield, Mass. Shell molding materials and equipment. **Booths No. 2014, 2112**

Simplicity Engineering Co., Durand, Mich. Conveying equipment and accessories, material handling equipment and accessories, sand handling and conditioning equipment and accessories, sand reclamation equipment, shakeout equipment and accessories. **Booths No. 1921-1929**

Sipi Metals Corp., Chicago. Non-ferrous alloys, fluxes, aluminum and copper-base ingots. **Booth No. 223**

G. E. Smith, Inc., Pittsburgh, Pa. Core and mold washes, core binders, core oils. **Booth No. 211**

Spencer Turbine Co., Hartford, Conn. Blowers, conveying equipment and accessories. **Booth No. 2221**

Spo, Inc., Cleveland. Coremaking equipment and accessories, molding machines, shell molding materials and equipment. **Booths No. 2022-2024**

Square D Co., Electric Controller & Mfg. Div., Cleveland. Electrical equipment and controls, magnets. **Booth No. 1052**

Standard Horse Nail Corp., New Brighton, Pa. Chaplets and nails. **Booth No. 319-A**

Steel Shot & Grit Co. See Pittsburgh Crushed Steel Co.

Sterling National Industries, Inc., Milwaukee. Flasks and accessories. **Booth No. 1321**

Frederic B. Stevens, Inc., Detroit. Foundry facings, foundry supplies and equipment. **Booth No. 1016**

Stroman Furnace & Engineering Co., Franklin Park, Ill. Blowers, core and mold ovens, non-ferrous melting furnaces, mold ovens and dryers, core ovens. **Booth No. 2138**

Sutter Products Co., Holly, Mich. Core blowers, core draw machines, shell core and shell molding equipment. **Booths No. 2124, 2223**

Tabor Mfg. Co., Lansdale, Pa. Cleaning and finishing equipment and accessories, dust control equipment and accessories, engineering services, molding machines, vibrators. **Booth No. 1401**

Taggart Brimfield Co., Hammonton, N. J. Sand. **Booth No. 811**

G. H. Tennant Co., Minneapolis. Foundry sweepers (vacuum equipped), industrial floor maintenance machines. **Booth No. 318**

Tocco Div., Ohio Crankshaft Co., Cleveland. Ferrous and non-ferrous melting furnaces. **Booth No. 506**

Tylene Plastics, Inc., Michigan City, Ind. Plastics, pattern shop equipment and supplies. **Booth No. 1822**

Union Carbide Corp. See Electro Metallurgical Co., Linde Co., National Carbon Co., New York.

United Oil Mfg. Co., Erie, Pa. CO₂ equipment and supplies, core and mold washes, core binders, core oils, mold and core washes. **Booth No. 713**

United States Electrical Tool Co., Cincinnati. Grinding equipment and accessories, portable tools. **Booths No. 1821-1823**

United States Forge & Foundry Co., Pulaski, N. Y. See Nolan Machinery Co.

United States Gypsum Co., Chicago. Matchplates and patterns, pattern shop equipment and supplies. **Booth No. 702**

U. S. Reduction Co., East Chicago, Ind. Non-ferrous alloys, aluminum ingots. **Booth No. 320**

Valvair Corp., Akron, Ohio. Material handling equipment. Hydraulic and air valves. **Booths No. 1543-1545**

Vesuvius Crucible Co., Pittsburgh, Pa. Crucibles, graphite products. **Booth No. 314**

Westinghouse Electric Corp., Industrial Electronics Dept., Baltimore, Md. Ferrous and non ferrous melting furnaces. **Booth No. 111**

Westover Corp., Milwaukee. Conveying equipment and accessories, engineering services, material handling equipment and accessories, sand handling and conditioning equipment and accessories, shakeout equipment and accessories. **Booths No. 1945-1947**

Wheelabrator Corp., Mishawaka, Ind. Abrasives, air pollution control equipment, blast cleaning equipment and accessories, cleaning and finishing equipment and accessories, dust control equipment and accessories, heating and ventilating equipment and accessories, sand handling and conditioning equipment and accessories, ventilating and heating equipment and accessories. **Booths No. 2222-2234**

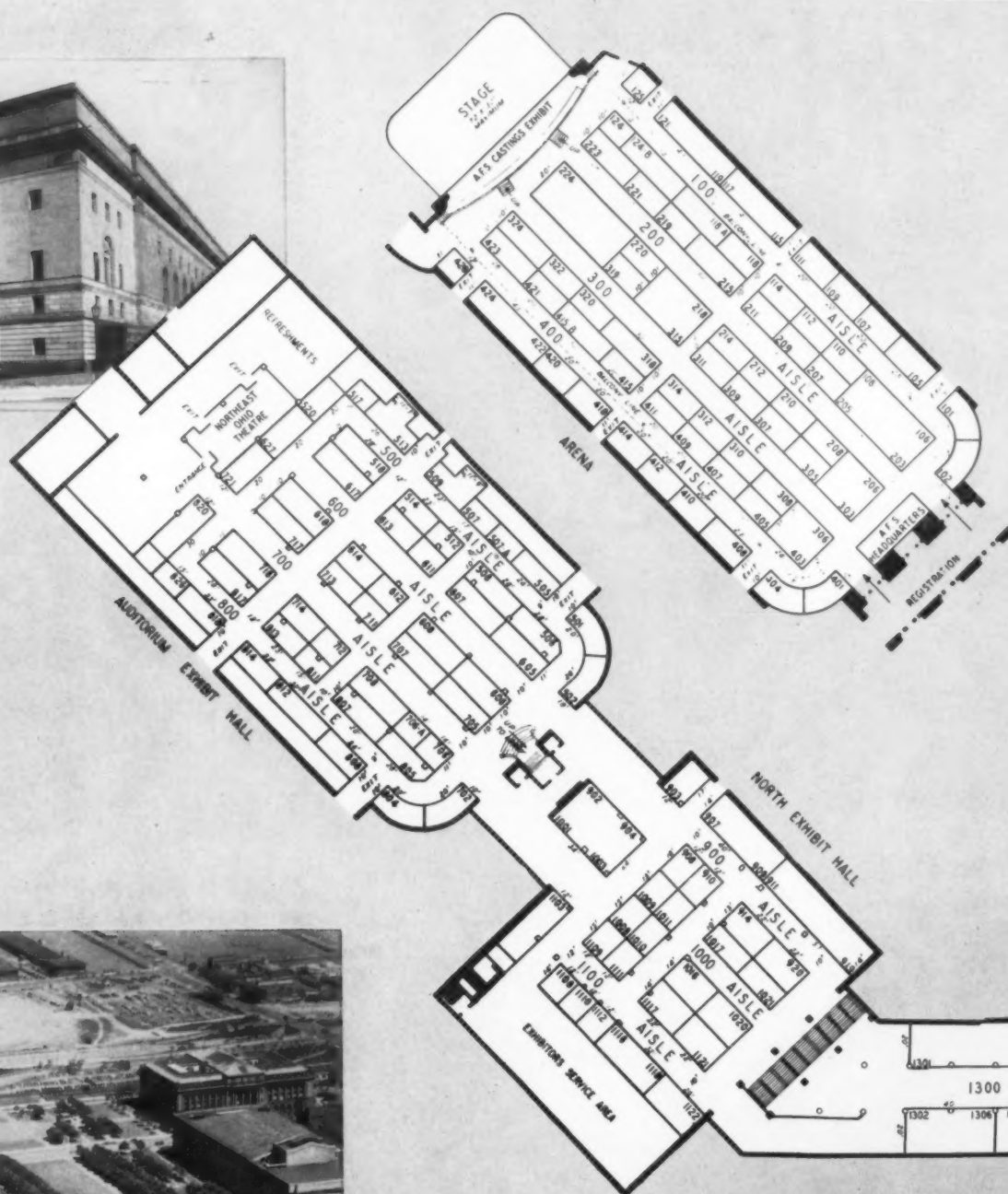
Whirl-Air-Flow Corp., Minneapolis. Conveying equipment and accessories, material handling equipment and accessories. **Booths No. 1048, 1747**

Whitehead Brothers Co., New York. Abrasives, clay, CO₂ equipment and supplies, core and mold washes, core binders, facings, foundry supplies, mold and core washes, sand, shell molding materials and equipment. **Booth No. 1322**

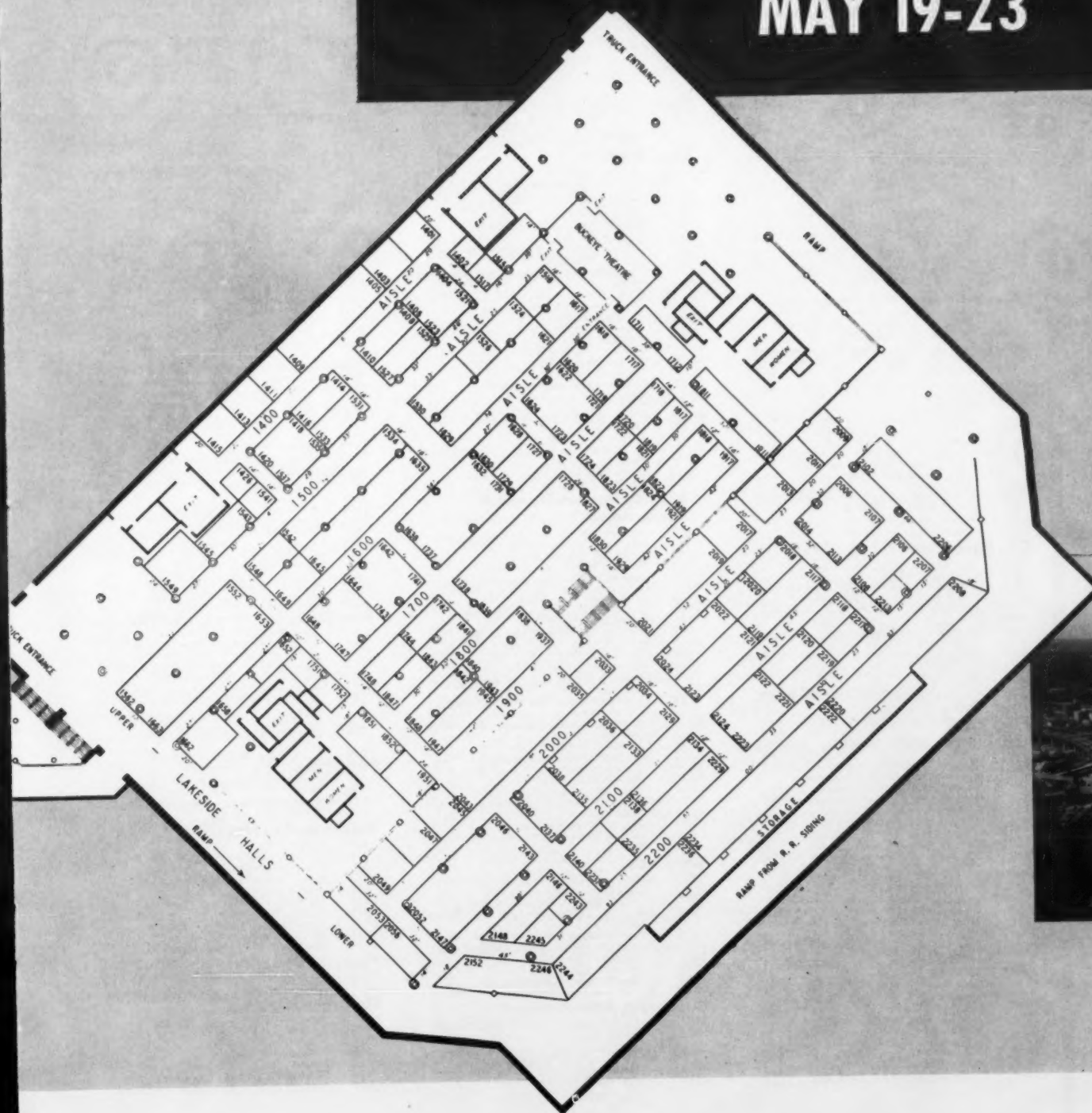
White Pine Lumber Co., Chicago. Pattern shop equipment and supplies. **Booth No. 1103**

Whiting Corp., Harvey, Ill. Conveying equipment and accessories, cranes and hoists, cupolas and accessories, electrodes, hoists and cranes, ladles, material handling equipment and accessories. **Booths No. 2236-38, 2240-44**

Yale & Towne Mfg. Co., Philadelphia. Hoists and cranes, material handling equipment and accessories. **Booths No. 1728-1738, 1827-1839**



FLOOR PLAN AFS SHOW CLEVELAND PUBLIC AUDITORIUM MAY 19-23



OFFICIAL GUIDE TO PRODUCTS ON EXHIBIT



Abrasives (Blasting, Grinding)

- 910 Alloy Metal Abrasive Co.
- 697 American Steel Abrasives Co.
- 697 Clayton-Sherman Abrasive Div.
- 1518 Cleveland Metal Abrasive Co.
- 718 Electro Refractories & Abrasives Corp.
- 1121 Fox Grinders, Inc.
- 697 Globe Steel Abrasives Co.
- 112 Daniel Goff Co. & Jesse S. Morie Son, Inc.
- 215 Hickman, William & Co.
- 219 National Metal Abrasive Co.
- 2033 Pangborn Corp.
- 902 George F. Pettinos, Inc.
- 607 Pittsburgh Crushed Steel Co.
- 420 H. B. Reed & Co.
- 607 Steel Shot & Grit Co.
- 2222 Wheelabrator Corp.
- 1322 Whitehead Brothers Co.

Air Compressors & Accessories

- 2045 Davey Compressor Co.
- 911 Eastern Clay Products Dept.
- 1742 A. Schramm's Son
- 1851 Schramm, Inc.

Alloys (Ferrous)

- 404 Alloy Metal Products, Inc.
- 415 Aluminum Co. of America
- 420 American Silica Sand Co.
- 518 Carborundum Co.
- Electro Minerals Div.
- 1301 Electro Metallurgical Co., Div. Union Carbide Corp.
- 808 Exomet, Incorporated
- 215 Hickman, William & Co.
- 106 International Nickel Co.
- 312 Ohio Ferro-Alloy Corp.

Alloys (Non-ferrous)

- 404 Alloy Metal Products, Inc.
- 1402 American Alloys Corp.
- 508 American Smelting and Refining Co.
- 214 Apex Smelting Co.
- 124 Brush Beryllium Co.
- 808 Exomet, Inc.
- 509 Benj. Harris & Co.
- 106 International Nickel Co.
- 920 Kaiser Aluminum & Chemical Sales, Inc.
- 1310 H. Kramer & Co.
- 1951 R. Lavin & Sons, Inc.
- 507-A Niagara Falls Smelting & Refining Div.
- 903 North American Smelting Co.
- 312 Ohio Ferro-Alloy Corp.
- 705 Olin Mathieson Chemical Corp.
- 125 Roessing Bronze Co.
- 820 I. Schumann & Co.
- 223 Sipl Metals Corp.
- 320 U. S. Reduction Co.

Blowers

- 2221 Spencer Turbine Co.
- 2138 Stroman Furnace & Eng. Co.
- 2124 Sutter Products Co.

Briquetting Equipment

- 2134 C. O. Bartlett & Snow Co.
- 2036 Jeffrey Mfg. Co.

Centrifugal Casting Equipment

- 307 Centrifugal Casting Machine Co.
- 2117 Herman Pneumatic Machine Co.

Chaplets and Nails

- 1408 Fanner Mfg. Co.
- 319-B Standard Horse Nail Corp.

Clay (Bonding)

- 1117 American Colloid Co.
- 101 American Fire Clay & Products Co.
- 908 Archer-Daniels-Midland Co.
- 209 Davis Fire Brick Co.
- 911 Eastern Clay Products Dept.
- 112 Daniel Goff Co. & Jesse S. Morie & Son, Inc.
- 322 Great Lakes Foundry Sand Co.
- 305 Harbison-Walker Refractories Co.
- 215 Hickman, Williams & Co.
- 807 Illinois Clay Products Co.
- 1526 Magnet Cove Barium Corp.
- 1322 Whitehead Brothers Co.

Cleaning & Finishing Equipment & Accessories

- 124-B A. I. C. Engineering Co.
- 2018 Ajem Laboratories, Inc.
- 2217 American-Marietta Co.
- 607 American Steel Abrasives Co.
- 2134 C. O. Bartlett & Snow Co.
- 2018 Centri-Spray Corp.
- 607 Clayton-Sherman Abrasive Div.
- 607 Globe Steel Abrasive Co.
- 2118 Latrobe Steel Co.
- 2033 Pangborn Corp.
- 607 Pittsburgh Crushed Steel Co.
- 607 Steel Shot & Grit Co.
- 1491 Tabor Mfg. Co.
- 2222 Wheelabrator Corp.

CO₂ Equipment & Supplies

- 319-A Air Reduction Co.
- 324 Alphaco, Inc.
- 908 Archer-Daniels-Midland Co.
- 1405 Carver Foundry Products
- 2140 Delhi Foundry Sand Co.
- 605 Delta Oil Products Corp.
- 2140 Demmler Mfg. Co.
- 421 Diamond Alkali Co.
- 911 Eastern Clay Products Dept.
- 2102 Foundry Services, Inc.
- 2108 Fritz Hansberg Co.
- 322 Great Lakes Foundry Sand Co.
- 215 Hickman, Williams & Co.
- 1531 Hill & Griffith Co.
- 1727 International Foundry Supply Co.
- 1418 International Molding Machine Co.
- 1525 Liquid Carbonic Div.
- 2208 National Engineering Co.
- 308 New Jersey Silica Sand Co.
- 705 Olin Mathieson Chemical Corp.
- 1722 Redford Iron & Equipment Co.
- 410 United States Forge & Foundry Co.
- 713 United Oil Mfg. Co.
- 1322 Whitehead Brothers Co.

Coke

- 421 Diamond Alkali Co.
- 401 Great Lakes Carbon Corp.
- 322 Great Lakes Foundry Sand Co.
- 215 Hickman, Williams & Co.
- 708 Semet-Solvay Div.

Conveying Equipment & Accessories

- 2134 C. O. Bartlett & Snow Co.
- 1552 Beardsley & Piper Div.
- 1838 C & S Products Co.
- 2133 Carrier Conveyor Corp.
- 2018 Centri-Spray Corp.
- 2013 Cleveland Vibrator Co.
- 2046 F.E. (North America) Ltd.
- 2036 Jeffrey Mfg. Co.
- 2208 National Engineering Co.

- 1642 Newaygo Engineering Co.
- 1921 Simplicity Engineering Co.
- 2221 Spencer Turbine Co.
- 1945 Westover Corp.
- 1648 Whirl-Air-Flow Corp.
- 2236 Whiting Corp.

Core and Mold Ovens and Dryers

- 2019 Foundry Equipment Co.
- 2121 Girdler Div.
- 411 Carl Mayer Corp.

Core and Mold Washes

- 101 American Fire Clay & Products Co.
- 908 Archer-Daniels-Midland Co.
- 1405 Carver Foundry Products
- 114 Corn Products Sales Co.
- 505 Dayton Oil Co.
- 605 Delta Oil Products Corp.
- 911 Eastern Clay Products Dept.
- 2102 Foundry Services, Inc.
- 1531 Hill & Griffith Co.
- 611 Lava Crucible Refractories Co.
- 1635 Link-Belt Co.
- 712 National Crucible Co.
- 1617 J. S. McCormick Co.
- 617 S. Obermayer Co.
- 902 George F. Pettinos, Inc.
- 211 G. E. Smith, Inc.
- 713 United Oil Mfg. Co.
- 1322 Whitehead Brothers Co.

Core Binders

- 1117 American Colloid Co.
- 908 Archer-Daniels-Midland Co.
- 414 Baroid Div. National Lead Co.
- 1405 Carver Foundry Products
- 505 Dayton Oil Co.
- 605 Delta Oil Products Corp.
- 421 Diamond Alkali Co.
- 911 Eastern Clay Products Dept.
- 1531 Hill & Griffith Co.
- 1727 International Foundry Supply Co.
- 1617 J. S. McCormick Co.
- 1548 Monsanto Chemical Co.
- 617 S. Obermayer Co.
- 1318 Penn-Rilliton Co.
- 1020 Penola Oil Co.
- 902 George F. Pettinos, Inc.
- 211 G. E. Smith, Inc.
- 713 United Oil Mfg. Co.
- 1322 Whitehead Brothers Co.

Core Oils

- 908 Archer-Daniels-Midland Co.
- 505 Dayton Oil Co.
- 605 Delta Oil Products Corp.
- 1617 J. S. McCormick Co.
- 1020 Penola Oil Co.
- 211 G. E. Smith, Inc.
- 713 United Oil Mfg. Co.

Coremaking Equipment & Accessories

- 2217 American-Marietta Co.
- 908 Archer-Daniels-Midland Co.
- 1552 Beardsley & Piper Div.
- 507 Burr Aluminum Products
- 1838 C & S Products Co.
- 1405 Carver Foundry Products
- 2140 Demmler Mfg. Co.
- 1010 Dependable Pattern Works
- 109 Devcon Corp.
- 1021 Dill-Co-Seal, Inc.
- 2046 F. E. (North America) Ltd.
- 118-A Glover Mfg. Co.
- 1711 Greenlee Bros. & Co.
- 2108 Fritz Hansberg Co.
- 2243 Harrison Machine Co.
- 1727 International Foundry Supply Co.
- 1418 International Molding Machine Co.
- 1525 Liquid Carbonic Div.
- 321 Martin Engineering Co.
- 2208 National Engineering Co.
- 1532 Osborn Mfg. Co.
- 2022 Sjo. Inc.
- 1722 Redford Iron & Equipment Co.
- 1917 Shalco Corp.
- 2124 Sutter Products Co.
- 410 United States Forge & Foundry Co.

Crucibles

- 418 American Refractories & Crucible Corp.
- 805 Joseph Dixon Crucible Co.
- 718 Electro Refractories & Abrasives Corp.
- 401 Great Lakes Carbon Corp.
- 611 Lava Crucible Refractories Co.
- 1301 National Carbon Co. Div.
- 712 National Crucible Co.
- 1426 Ross-Tacony Crucible Co.
- 314 Vesuvius Crucible Co.

Cupolas & Accessories

- 2134 C. O. Bartlett & Snow Co.
- 1662 Brown Thermal Development Co.
- 911 Eastern Clay Products Dept.
- 2213 Galland-Henning Mfg. Co.
- 1622 Modern Equipment Co.

- 409 North State Pyrophyllite Co.
- 2236 Whiting Corp.

Die Casting Equipment & Accessories

- 1727 International Foundry Supply Co.

Educational

- 514 American Gas Association
- 1517 American Metal Market
- 407 American Society for Metals
- 706 Encyclopedia Britannica, Inc.
- 1524 Foundry Educational Foundation
- 1717 Foundry Equipment Manufacturers' Association
- 1616 Gray Iron Founders' Society
- 206 Modern Castings
- 1818 National Safety Council
- 812 Non-Ferrous Founders' Society
- 1530 Penton Publishing Co.

Electrical Equipment & Controls

- 1552 Beardsley & Piper Div.
- 1652 Electric Controller & Mfg. Div.
- 2237 Hartley Controls Corp.
- 1632 Osborn Mfg. Co.
- 1652 Square D Co.

Electrodes

- 1108 Arcair Co.
- 306 Eutectic Welding Alloys Corp.
- 401 Great Lakes Carbon Corp.
- 122 International Graphite & Electrode Div.
- 106 International Nickel Co.
- 1301 National Carbon Co. Div.
- 2236 Whiting Corp.

Engineering Services

- 124-B A. I. C. Engineering Co.
- 2018 Ajem Laboratories, Inc.
- 1848 American Automation Corp.
- 2134 C. O. Bartlett & Snow Co.
- 1838 C & S Products Co.
- 2133 Carrier Conveyor Corp.
- 2018 Centri-Spray Corp.
- 421 Diamond Alkali Co.
- 2046 F. E. (North America) Ltd.
- 1418 International Molding Machine Co.
- 106 International Nickel Co.
- 2036 Jeffrey Mfg. Co.
- 2034 Lester B. Knight & Associates, Inc.

- 1635 Link-Belt Co.
- 1718 Pekay Machine & Engineering Co.

- 1401 Tabor Mfg. Co.
- 1945 Westover Corp.

Facings (Mold)

- 1117 American Colloid Co.
- 908 Archer-Daniels-Midland Co.
- 1405 Carver Foundry Products
- 605 Delta Oil Products Corp.
- 911 Eastern Clay Products Dept.
- 1617 J. S. McCormick Co.
- 617 S. Obermayer Co.
- 1318 Penn-Rilliton Co.
- 902 George F. Pettinos, Inc.
- 1016 Frederic B. Stevens, Inc.
- 1322 Whitehead Brothers Co.

Fire Brick and Fire Clay Products

- 1117 American Colloid Co.
- 101 American Fire Clay & Products Co.
- 414 Baroid Div. National Lead Co.
- 209 Davis Fire Brick Co.
- 911 Eastern Clay Products Dept.
- 107 General Refractories Co.
- 112 Daniel Goff Co. & Jesse S. Morie & Son, Inc.
- 305 Harbison-Walker Refractories Co.
- 215 Hickman, Williams & Co.
- 807 Illinois Clay Products Co.
- 210 National Foundry Sand Co.
- 308 New Jersey Silica Sand Co.
- 409 North State Pyrophyllite Co.
- 617 S. Obermayer Co.

Flasks and Accessories

- 621 Adams Co.
- 813 American Foundry Flask Co.
- 507 Burr Aluminum Products
- 2219 Foundry Flask & Equipment Co.
- 612 Fremont Flask Co.
- 215 Hickman, Williams & Co.
- 606 Hines Flask Co.
- 1642 Newaygo Engineering Co.
- 415-A Products Engineering Co.
- 1321 Sterling Wheelbarrow Co.

Flexible Couplings

- 2036 Jeffrey Mfg. Co.
- 1635 Link-Belt Co.

Fluxes

- 319-A Air Reduction Co.
- 420 American Silica Sand Co.
- 214 Apex Smelting Co.
- 218 Cleveland Flux Co.
- 719 Delhi Foundry Sand Co.
- 421 Diamond Alkali Co.
- 306 Eutectic Welding Alloys Corp.

- 808 Ekomet, Inc.
2102 Foundry Services, Inc.
215 Hickman, Williams & Co.
1727 International Foundry Supply Co.
1301 Linde Co., Div.
507-A Niagara Falls Smelting & Refining Div.
224 Sipi Metals Corp.

Foundry Supplies

- 115 American Chain & Cable Co.
1117 American Colloid Co.
607 American Steel Abrasives Co.
908 Archer-Daniels-Midland Co.
607 Clayton-Sherman Abrasive Div.
719 Delhi Foundry Sand Co.
109 Devcon Corp.
518 Electro Minerals Div.
607 Globe Steel Abrasives Co.
305 Harbison-Walker Refractories Co.
1531 Hill & Griffith Co.
1617 J. S. McCormick Co.
1541 Indianapolis Wire Bound Box Co.
210 National Foundry Sand Co.
902 George F. Pettinos, Inc.
607 Pittsburgh Crushed Steel Co.
607 Steel Shot & Grit Co.
1016 Frederick P. Stevens, Inc.
1322 Whitehead Brothers Co.

Furnaces (Heat Treating)

- 1302 Ajax Electrothermic Corp.
411 Carl Mayer Corp.
1830 Inductotherm Corp.
1011 Laboratory Equipment Corp.

Furnaces, Melting (Ferrous)

- 1302 Ajax Electrothermic Corp.
1306 Ajax Engineering Corp.
1124 Detroit Electric Furnace Div.
1830 Inductotherm Corp.
1727 International Foundry Supply Co.

- 914 Lectromelt Furnace Div.
409 North State Pyrophyllite Co.
506 Ohio Crankshaft Co.

Furnaces, Melting (Non-Ferrous)

- 1302 Ajax Electrothermic Corp.
1306 Ajax Engineering Corp.
1658 Campbell-Hausfeld Co.
1124 Detroit Electric Furnace Div.
1830 Inductotherm Corp.
1727 International Foundry Supply Co.
1404 Lindberg Engineering Co.
506 Ohio Crankshaft Co.
2138 Stroman Furnace & Engineering Co.

Graphite Products

- 418 American Refractories & Crucible Corp.
908 Archer-Daniels-Midland Co.
805 Joseph Dixon Crucible Co.
401 Great Lakes Carbon Corp.
1531 Hill & Griffith Co.
807 Illinois Clay Products Co.
122 International Graphite & Electrode Div.
1301 National Carbon Co. Div.
712 National Crucible Co.
902 George F. Pettinos, Inc.
1426 Ross-Tacony Crucible Co.
314 Vesuvius Crucible Co.

Grinding Equipment & Accessories

- 718 Electro Refractories & Abrasives Corp.
1121 Fox Grinders, Inc.
1821 United States Electrical Tool Co.

Heating, Ventilating, Air Pollution Control Equipment & Accessories

- 907 American Air Filter Co.
2018 Ajem Laboratories, Inc.
2134 C. O. Bartlett & Snow Co.
411 Carl Mayer Corp.
2018 Centri-Spray Corp.
110 Illinois Testing Laboratories, Inc.
2220 National Dust Collector Corp.
2208 National Engineering Co.
2033 Pangborn Corp.
2120 Claude B. Schneible Co.
1401 Tabor Mfg. Co.
2222 Wheelabrator Corp.

Hoists and Cranes

- 2134 C. O. Bartlett & Snow Co.
323 Blaw-Knox Company
1628 Master Pneumatic Tool Co.
1728 Yale & Towne Mfg. Co.
2236 Whiting Corp.

INDUSTRIAL GASES

- 2129 National Cylinder Gas Co.

Ingots (Aluminum)

- 1402 American Alloys Corp.
721 American Smelting and Refining Co.
214 Apex Smelting Company
808 Ekomet, Inc.
920 Kaiser Aluminum & Chemical Sales, Inc.
1951 R. Lavin & Sons, Inc.
507-A Niagara Falls Smelting & Refining Div.
902 North American Smelting Co.
705 Olin Mathieson Chemical Corp.
125 Roessing Bronze Co.
224 Sipi Metals Corp.
320 U. S. Reduction Co.

Ingots (Copper-base)

- 1310 Ajax Metal Div.
721 American Smelting and Refining Co.
124 Brush Beryllium Co.
509 Benj. Harris & Co.
412 Interstate Smelting & Refining Co.
1310 H. Kramer & Co.
1951 R. Lavin & Sons, Inc.
1301 Linde Co. Div.
118 Nassau Smelting & Refining Co.
507-A Niagara Falls Smelting & Refining Div.
903 North American Smelting Co.
125 Roessing Bronze Co.
820 I. Schumann & Co.
224 Sipi Metals Corp.

Insulating Materials

- 418 American Refractories & Crucible Corp.
805 Joseph Dixon Crucible Co.
107 General Refractories Co.
807 Illinois Clay Products Co.
902 George F. Pettinos, Inc.

Laboratory and Scientific Equipment

- 1112 Alpha-Lux Co.
121 Applied Research Laboratories
1552 Beardsley & Piper Div.
1405 Carver Foundry Products
1841 Harry W. Dietert Co.
110 Illinois Testing Laboratories, Inc.
1011 Laboratory Equipment Corp.
804 Picker X-Ray Corporation
711 Pyrometer Instrument Co.
410 United States Forge & Foundry Co.

Ladles

- 2134 C. O. Bartlett & Snow Co.
719 Delhi Foundry Sand Co.
1622 Modern Equipment Co.
2236 Whiting Corp.

Lubricating Materials & Equipment

- 2013 Cleveland Vibrator Co.
605 Delta Oil Products Corp.

Matchplates and Patterns

- 1838 C & S Products Co.
109 Devcon Corp.
721 Furane Plastics, Inc.
221 Houghton Laboratories, Inc.
1649 Hutchinson Shell Mold Co.
310 Scientific Cast Products Corp.
702 U. S. Gypsum Co.

Material Handling Equipment & Accessories

- 124-B A.I.C. Engineering Co.
115 American Chain & Cable Co.
2134 C. O. Bartlett & Snow Co.
1552 Beardsley & Piper Div.
507 Burr Aluminum Products
1838 C & S Products Co.
2133 Carrier Conveyor Corp.
2018 Centri-Spray Corp.
2046 F.E. (North America) Ltd.
1549 Flick-Reddy Corp., Miller Fluid Power Div.
1534 Frank G. Hough Co.
2036 Jeffrey Mfg. Co.
1635 Link-Belt Co.
1110 Lowery Bros., Inc.
1622 Modern Equipment Co.
2208 National Engineering Co.
210 National Foundry Sand Co.
1718 Pékay Machine & Engineering Co.

- 517 Ross Operating Valve Co.
1921 Simplicity Engineering Co.
1543 Valvair Corp.
1945 Westover Corp.
1648 Whirl-Air-Flow Corp.
2236 Whiting Corp.
1728 Yale & Towne Mfg. Co.

Molding Machines

- 621 Adams Co.
908 Archer-Daniels-Midland Co.
1552 Beardsley & Piper
1817 British Moulding Machine Co. Ltd.

- 1838 C & S Products Co.
1405 Carver Foundry Products
911 Eastern Clay Products Dept.
2046 F.E. (North America) Ltd.
2108 Fritz Hansberg Co.
2117 Herman Pneumatic Machine Co.
1418 International Molding Machine Co.
215 Hickman, Williams & Co.
1403 Wm. H. Nicholls Co.
1632 Osborn Mfg. Co.
1917 Shalco Corp.
2022 Spo, Inc.
1401 Tabor Mfg. Co.

Noise & Shock Absorption Materials

- 124-B A.I.C. Engineering Co.

Non-destructive Testing Equipment & Accessories

- 2018 Centri-Spray Corp.
513 Magnadux Corp.
804 Picker X-Ray Corp.

Pattern Shop Equipment & Supplies

- 1405 Carver Foundry Products
109 Devcon Corp.
1625 Freeman Supply Co.
721 Furane Plastics, Inc.
118-A Glover Mfg. Co.
221 Houghton Laboratories, Inc.
1824 High Sierra Pine Mills, Inc.
1727 International Foundry Supply Co.
2040 Kindt-Collins Co.
321 Martin Engineering Co.
618 Oliver Machinery Co.
1621 PMS Co.
814 Rezolin, Inc.
1822 Tyleno Plastics, Inc.
1103 White Pine Lumber Co.
702 U. S. Gypsum Co.

Pyrometers

- 110 Illinois Testing Laboratories, Inc.
711 Pyrometer Instrument Co.

Refractories (Brick, Linings)

- 1112 Alpha-Lux Co.
418 American Refractories & Crucible Corp.
614 Blastcrete Service Co.
209 Davis Fire Brick Co.
805 Joseph Dixon Crucible Co.
911 Eastern Clay Products Dept.
718 Electro Refractories & Abrasives Corp.
107 General Refractories Co.
401 Great Lakes Carbon Corp.
305 Harbison-Walker Refractories Co.
215 Hickman, Williams & Co.
807 Illinois Clay Products Co.
419 Keystone Refractories Co.
611 Lava Crucible Refractories Co.
1301 National Carbon Co. Div.
712 National Crucible Co.
210 National Foundry Sand Co.
409 North State Pyrophyllite Co.
1426 Ross-Tacony Crucible Co.

Safety Clothing, Equipment

- 207 Brown Co.
714 Mine Safety Appliances Co.
2033 Pangborn Corp.

Sand (Core and Mold)

- 1117 American Colloid Co.
420 American Silica Sand Co.
501 Arrowhead Co.
1712 Continental Silica Co.
719 Delhi Foundry Sand Co.
112 Daniel Goff Co.
Jesse S. Morie & Son, Inc.
322 Great Lakes Foundry Sand Co.
818 Hardy Sand Co.
215 Hickman, Williams & Co.
807 Illinois Clay Products Co.
501 Manley Bros.
102 Manley Sand Co.
501 Lyle T. Manley Co.
308 New Jersey Silica Sand Co.
512 Oretraction
902 George F. Pettinos, Inc.
704-A Sand Products Corp.
811 Taggart Brimfield Co.
1322 Whitehead Brothers Co.

Sand Handling and Conditioning Equipment & Accessories

- 908 Archer-Daniels-Midland Co.
2134 C. O. Bartlett & Snow Co.
1552 Beardsley & Piper Div.
1838 C & S Products Company, Inc.
2133 Carrier Conveyor Corp.
502 Clearfield Machine Co.
2013 Cleveland Vibrator Co.
1841 Harry W. Dietert Co.
2046 F.E. (North America) Ltd.
2237 Hartley Controls Corp.

- 1524 Frank G. Hough Co.
2036 Jeffrey Mfg. Co.
2118 Latrobe Steel Co.
1635 Link-Belt Co.
2052 Moulders' Friend
2318 National Air Conveyor Corp.
2208 National Engineering Co.
1642 Newaway Engineering Co.
1718 Pékay Machine & Eng. Co.
2229 Royer Foundry & Machine Co.
1921 Simplicity Engineering Co.
2124 Sutter Products Co.
1945 Westover Corp.
2222 Wheelabrator Corp.

Sand Reclamation Equipment (Core and Mold)

- 2217 American-Marletta Co.
908 Archer-Daniels-Midland Co.
2134 C. O. Bartlett & Snow Co.
1552 Beardsley & Piper Div.
1405 Carver Foundry Products
2046 F.E. (North America) Ltd.
2036 Jeffrey Mfg. Co.
1675 Link-Belt Co.
2118 Latrobe Steel Co.
1921 Simplicity Engineering Co.

Shakeout Equipment & Accessories

- 124-B A.I.C. Engineering Co.
115 American Chain & Cable Co.
1552 Beardsley & Piper Div.
2134 C. O. Bartlett & Snow Co.
2013 Cleveland Vibrator Co.
2046 F.E. (North America) Ltd.
2036 Jeffrey Mfg. Co.
1635 Link-Belt Co.
2229 Royer Foundry & Machine Co.
1921 Simplicity Engineering Co.
1945 Westover Corp.

Shaw Process

- 405 British Industries Corp.

Shell Molding Materials & Equipment

- 1751 Acme Resin Corp.
607 American Steel Abrasives Co.
908 Archer-Daniels-Midland Co.
2134 C. O. Bartlett & Snow Co.
1552 Beardsley & Piper Div.
1838 C & S Products Co.
607 Clayton-Sherman Abrasive Div.
1010 Dependable Pattern Works
109 Devcon Corp.
613 Durez Plastics Div.
911 Eastern Clay Products Dept.
2046 F. E. (North America) Ltd.
607 Globe Steel Abrasives Co.
322 Great Lakes Foundry Sand Co.
2108 Fritz Hansberg Co.
305 Harbison-Walker Refractories Co.

- 2243 Harrison Machine Co.
1649 Hutchinson Shell Mold Co.
1635 Link-Belt Co.
1548 Monsanto Chemical Co.
2208 National Engineering Co.
308 New Jersey Silica Sand Co.
1632 Osborn Mfg. Co.
607 Pittsburgh Crushed Steel Co.
2022 Spo, Inc.
607 Steel Shot & Grit Co.
1917 Shalco Corp.
2014 Shell Process, Inc.
2124 Sutter Products Co.
1322 Whitehead Brothers Co.

Temperature Control and Recording Devices

- 110 Illinois Testing Laboratories, Inc.
711 Pyrometer Instrument Co.

Trucks and Tractors

- 1552 Beardsley & Piper Div.

Vacuum Cleaning Equipment

- 318 G. H. Tennant Co.

Vibrators

- 621 Adams Co.
2013 Cleveland Vibrator Co.
1414 International Molding Mach. Co.
1635 Link-Belt Co.
321 Martin Engineering Co.
1632 Osborn Mfg. Co.
1401 Tabor Mfg. Co.

Wash Room Equipment & Supplies

- 2207 Bradley Washfountain Co.
207 Brown Co.

Welding and Cutting Equipment & Accessories

- 319-A Air Reduction Co.
1108 Arcair Co.
306 Eutectic Welding Alloys Corp.
808 Ekomet, Inc.
106 International Nickel Co.
1301 National Carbon Co. Div.

X-ray and Radium

- 804 Picker X-Ray Corp.



OFFICIAL AFS AWARDS



GOLD MEDAL AWARDS



Ralph A. Clark

Pangborn Gold Medal

"For outstanding contributions to the Society and the ferrous casting industry, especially in the field of gray iron metallurgy."

Clark, manager of foundry services, Electro Metallurgical Co., Div., Union Carbide Corp., Cleveland, has written many articles for technical and trade magazines; and talked before many AFS meetings and Conventions.



Howard J. Rowe

McFadden Gold Medal

"For outstanding contributions to the Society and to the light metals branch of the casting industry."

Rowe, chief metallurgist, Castings Div., Aluminum Co. of America, Pittsburgh, Pa., has authored several technical papers and contributed to two AFS basic technical publications. He has chaired several committees in the AFS Light Metals Division.



Wm. W. Maloney

Seaman Gold Medal

"For enthusiastic leadership and completely unselfish devotion to the Society as its Secretary and General Manager."

Maloney, AFS Secretary and General Manager, joined the AFS staff in 1929 to publish the Society's first magazine. He was elected Secretary in 1945, and Secretary-Treasurer in 1946. His title was later changed to General Manager.



AWARDS OF SCIENTIFIC MERIT



Mervin H. Horton

"For technological contributions over many years to the Gray Iron and Sand Divisions of the Society."

Horton, supervisor of foundry service, Deere & Co., Moline, Ill., has presented talks before AFS Conventions and has served as Chairman, AFS Quad City Chapter. He has been active on numerous AFS and A.S.M. technical committees.



Kenneth H. Priestley

"For long and conscientious effort in the development of gray iron shop course programs at the AFS Annual Castings Congress."

Priestley, president and metallurgist, Vassar Electroloy Products, Inc., Vassar, Mich., has talked before AFS Chapters and Regional Conferences; has served on Michigan Regional Foundry Conference committees and in various Chapter positions.



Franklin B. Rote

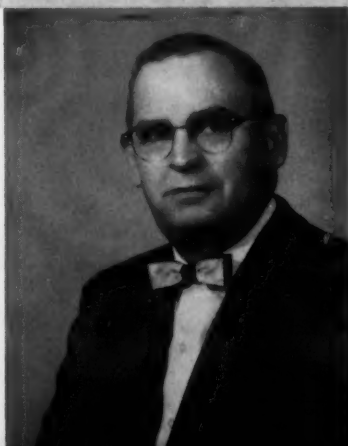
"For noteworthy contributions to the AFS Malleable Division in furthering the technical prestige of the Society."

Rote, technical director, Albion Malleable Iron Co., Albion, Mich., has served as Chairman, AFS Malleable Division and has talked before AFS and A.S.M. Chapters. He has co-authored nearly 20 papers appearing in technical and trade journals.

Frank S. Brewster

"For valuable service to the Society and the castings industry in the development and dissemination of basic sand technology."

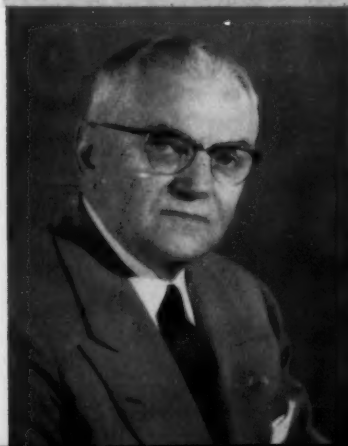
Brewster, director of research and development, Brumley-Donaldson Co., Huntington Park, Calif., was Chairman, AFS Sand Division; has published several technical papers and contributed to the AFS MOLDING SAND HANDBOOK.



Ernest T. Kindt

"For faithful and continuous service to the Society and the patternmaking branch of the castings industry."

Kindt, president, Kindt-Colins Co., Cleveland, has spoken before AFS chapters and Conventions for more than 15 years, including the 61st Casting Congress. At that time he presented his observations on European patternmaking.



Fred G. Sefing

"For long and conscientious service to AFS and the castings industry in fostering foundry educational programs at all levels."

Sefing, metallurgist, Development & Research Div., International Nickel Co., New York, is the author of 11 technical papers or articles and co-author of seven. He is a past AFS Director, and has served on various AFS technical committees.



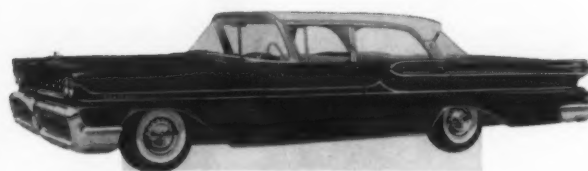
AFS SERVICE CITATIONS



If You're an AFS Member . . .
and attend the 1958 Castings Congress . . .
You may WIN

A 1958 MODEL MOTOR CAR

American Foundrymen's Society has just announced that it will give away three fine 1958 model automobiles to Society members attending its 62d Castings Congress and Foundry Show in Cleveland, May 19-23. The three cars are being supplied by Ford, General Motors and Chrysler, and will be on display all week in the Arena exhibit hall of Cleveland's Auditorium. An extensive display of castings stressing the importance of "Automotive Castings for Modern Living" will augment the car displays.



■ Public drawing for the cars will take place at 3:00 pm, Fri. May 23, on the Arena stage. Eligibility rules and all "contest" details have been drawn up by a special committee of the industry, which will rule on all entries and declare the final winners following the Convention. As approved by the Society's Board of Directors, eligibility is limited to members whose duties are not actively connected with selling products or services to castings producers. Thus the car drawing becomes an added incentive for attendance by those for whose benefit the Castings Congress and Foundry Show are primarily staged.

■ Other rules for this unique event as announced thus far: Entrants must be present at the Congress and register in person for car drawings; no entry fee except the usual Convention registration fee, \$2.00 for AFS members; members eligible must be "in good standing" as of Fri. May 23; entries close May 23 at 2 pm. All have equal opportunity to win one of the cars, whether attending the Congress one day or five.

1958

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Foundry Practice for Sand Casting Commercially Pure Aluminum

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To obtain the greatest benefits from attending the technical sessions of the 62d Castings Congress, bring along your file of the papers that have been pre-printed in MODERN CASTINGS. Keep them handy for reference and discussion.

THE PARLANTI MOULD PROCESS FOR THE CASTING OF METAL BY CONTROLLED RATE OF HEAT TRANSFER

By

Dr. Conrad A. Parlanti* and Rodger D. Veneklasen**

INTRODUCTION

The Parlanti Mould Process comprises a method of controlling the even-cooling of a cast mass in order to obtain optimum physical test figures in castings at least comparable to the test bar figures expected from any particular alloy. Until now the philosophy in the foundry has been to search for alloys that would lend themselves to the variable conditions brought about by the design of the part and to ascertain possible processes to cast such parts.

It is one thing to think in terms of alloys in test bars, billets or ingots that will give good physical test results. But one has to bear in mind also the effect of the process of casting upon such metal by taking into account the inequalities of the metal mass brought about by the peculiar design of the part to be cast.

Let us compare briefly sand and permanent mold castings. In sand castings, as in all castings, we have to contend, first, with the heat carried in with the molten metal; and, second, with the filling of the mold cavity with this flow of energized mass. This mass has to settle and cool off from a liquid to a solid state. The metal gives off this heat which varies in proportion to its own cubic content of retained heat. As the heat is given off by the molten metal, it is refracted back by the sand grains. The amount of refracted heat will depend, first, on the heat produced from the flow of molten metal; and, second, on the heat contained in the varying sections of the casting.

Risers can help the variations in contraction, but can not promote even solidification because the refracted heat deviates according to the section volumes of the cast mass. By relating physical test bars taken from

these differing sections, the effect of this unbalanced cooling rate will be shown. Comparing the phase diagrams for the various alloys will also give further proof of this effect.

What about permanent molds? In this case the mold is saturated with heat at certain sections in an attempt to even the cooling rate proportional to the variation in the cubic volume of the casting. By doing so the time of cooling is lengthened. By this means it is possible to even out the stresses imposed on the part because of this applied heat, and at the same time, pass the mass of metal required for the riser through the body of the mold. This results in a temperature drop in the riser, compensated for by the temperature increase of the mold. On cooling from a liquid to a solid state, the cast mass is left to the mercy of its inequalities of cooling, depending on the configuration of the cast mass. Again the inadequate results of this method can easily be seen by taking tensile test bars from the various parts of the casting.

Now, what is the best way to deal with this problem of transferring heat from the cast mass in as fast, but yet, as balanced a manner as possible? The first criterion is that the mold material obviously must have a good and equal rate of heat conduction. It must also be easily machined and protected as much as possible from heat absorption. What materials are available? Most common are copper, aluminum, magnesium and silver. The cooling curves shown on Fig. 1 suggest aluminum, when anodized, as the most suitable.

Even with no heat applied to the mold, it can readily be seen how well the cooling of the cast mass responds to the variation in the thickness in the mold. This difference is brought about by the mold's requirements to meet the design specification of the part to be cast.

*President and **Chief Metallurgist, Niforge Engineered Castings, Inc., Boston, Mass.

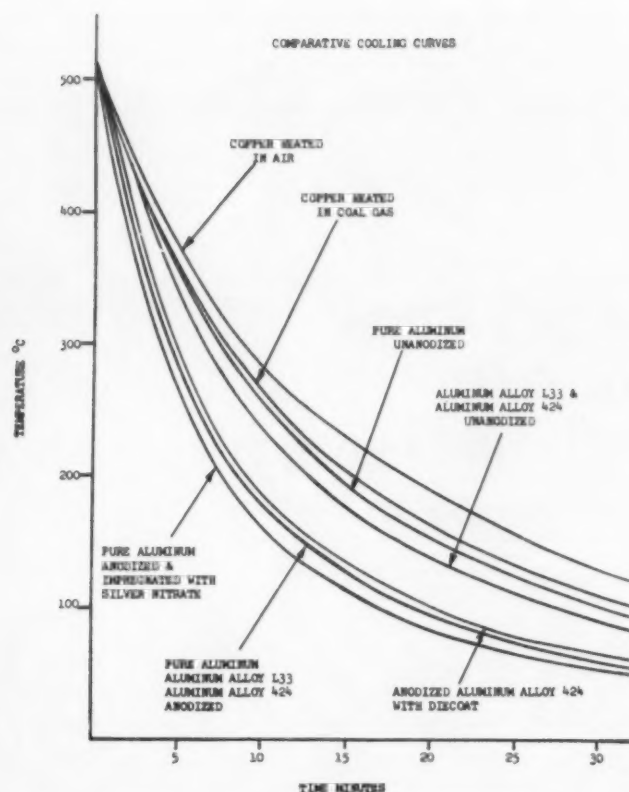


Fig. 1 — Cooling rate of various metal mold materials.

With these cooling requirements, which can be measured and adjusted to an even finer point by additional cooling fins on the mold and/or by differences in anodizing, the required amount of feed necessary to complete the job can be determined.

Once mold conditions are set, specific alloys may be designed for specific uses. The resultant casting will respond to the even cooling rate and reproduce the physical figures obtained in the simple casting, such as a test bar. Table 1 shows how a properly designed, anodized, aluminum mold can deal with these casting problems.

TABLE 1 — MECHANICAL PROPERTIES OF ALUMINUM CASTINGS

Alloy type	Nominal composition	Condition	Type of mold	Tensile strength, psi (typical)	Yield strength, psi at 0.2% (typical)	Elongation, % (typical)
195	4.5 Cu	Heat Treated	Permanent	45-48,000	40-45,000	1-2
		Heat Treated I	Anodized*	55,000	45,000	6-8
		Heat Treated II	Anodized*	40,000	32,000	15

*Parlanti: Mould Process

CAUSE AND EFFECTS

Before discussing the effects of the Parlanti Mould system on a casting, first examine the causes that produce these effects. The mold is made of aluminum, which is anodized; and the rate and flow of heat conduction through this mold depends largely on the mold construction. Producing the mold from a sand casting is one way to make it. Permanent molding the die section is another way. Machining from a billet is still a third method. The ratio of heat conduction is, naturally, affected by the method selected. The

anodizing must also be taken into consideration. The aluminum alloy and method chosen will obviously have for its anodizing an electrolyte current density and temperature best suited for its particular rate of heat conduction. These points will be discussed more fully in a later section.

In short, the process makes use of the high-thermal conductivity of aluminum to control both the direction and the rate of heat transfer from the molten metal. The aluminum mold and the face which comes in direct contact with the molten metal is deeply anodized. The anodized layer, essentially Al_2O_3 , has a melting point over 3700 F. It is also hard, and, therefore, resistant to erosion and wear, making possible repeated use of the mold. The anodized film, being a refractory with low thermal conductivity, momentarily checks the flow of heat from the metal as it is poured, keeping it from freezing too rapidly. This film also acts as a barrier enabling the mold to conduct the heat to the inner faces of the mold at a regulated rate without any great heat absorption in its own mass.

Thus the outer face of the mold is able to radiate the heat away from the mold at a faster rate than the heat is conducted through the mold. Combining these factors—the anodized inner film, the aluminum body, and the outer anodized film—all act in sequence to give a heat flow regulated the same way as one might adjust a valve for liquid flow.

As a net result, the first metal to enter the mold is the first to freeze. So controlled pouring produces progressive solidification of the part from the bottom up, the last metal to freeze being the header. Pouring can be rapid, but within the bounds necessary to eliminate turbulence. The solidification process results in a dense casting, while the high cooling rate produces fine grain, both of which contribute to improved mechanical properties of parts produced by this system.

The Parlanti Mould Process, then, is in contradiction to the low-thermal conductivity of molds made by sand, plastic and investment casting processes. In the latter cases, the mold material by its very nature prevents the start of metal solidification until the casting is completely poured. Even after the metal has filled the mold, heat dissipation is slow, with solidification starting at the skin of the casting and proceeding inward. This gradual solidification tends to promote the formation of large grains and dendritic structure. The metal next to the mold is the first to cool and this metal then becomes stronger as the temperature falls. At the same time the metal is shrinking. By the time the metal at the center of a heavy section solidifies, there is more space than it can fill, voids occur, and sizable cavities can result. Properties at the heavy sections are invariably lower than those at or near the skin.

All test bars by the Parlanti Mould Process are machined to 1/2-in. dia. gauge section from bars ranging in diameter from 1-1/4 in. to 1-1/2 in. and all test figures quoted by Niforge are based on this type of test bar. More valid figures are obtained from the inner core of the cast mass than the misleading figures obtained on a cast bar with a tenaciously hard skin which is quite frequently machined off or cut into.

EFFECT OF THE SYSTEM

In discussing the casting of metals at a controlled rate of heat transfer, it is important to think in terms of the optimum conditions necessary to adequately feed a solidifying mass of cast metal. This, of course, is as necessary to guarantee a satisfactory result as is the controlled rate of heat transfer. This adequate feed is the heart of the Parlanti Mould Process.

Thinking in terms of a contracting mass of a planetary system, stresses must be held to a minimum and, more important, no segregation of the mass should be permitted. This can best be done by supplying adequate feed to the cast mass. The feed must, of course, be at a higher temperature than the cast mass and in a position where its contact with the cast mass is adequate. The mold condition and the feed condition go hand in hand. They must be considered together. For this purpose it is important to consider three factors: 1) the necessity of providing a proper ratio of the volume of the feed cavity to the volume of the casting cavity; 2) the necessity for avoiding constriction between the feed cavity and the casting cavity; and 3) the necessity of having the transverse sections of the feed cavity increase in area away from the casting cavity.

The effect of this feed vs casting ratio can be seen by the test results of identical bars, machined out of test castings and subjected to identical standard procedures for determining ultimate tensile strength and percentage of elongation. The test castings were not heat-treated but were analyzed in the "as-cast" condition. Fig. 2 shows the results obtained in each test.

Specifically, the mold used in casting the test samples was of an anodized aluminum alloy. The casting cavity remained identical in each test but the feed cavity was altered in tests No. 4, 5, 6 and 7 to prove the importance of the correct positioning and extent of the feed.

In all tests, the volume of the casting cavity remained the same, approximately 8.5 cu in. In test No. 1 the volume of the feed cavity was approximately 18 cu in. and, when filled with metal to the level shown, it contained 17 cu in. corresponding to excess of the minimum expressed ratio.

Tests No. 2 and 3 were designed to prove the progressive deterioration of the cast metal originating from a decrease in the minimum ratio of the volume of the feed cavity to the volume of the casting cavity.

In these tests the conditions were precisely the same as in test No. 1 except that the volume of the feed cavity was decreased. Actually, for convenience in making test No. 2, the feed cavity was filled to approximately half of its capacity. While in test No. 3 the feed cavity was filled to roughly 1/3 its capacity. Thus, in test No. 2 it was estimated that the feed cavity contained approximately 8.5 cu in. of metal, or a ratio of about 1 to 1 with respect to the volume of the casting cavity—while in test No. 3 it was estimated that the feed cavity contained close to 6 cu in. of metal or, nearly, in a ratio of 0.75 to 1 with respect to the volume of the casting cavity.

Test No. 4, 5, and 6 were designed to prove the progressive deterioration of the cast metal under conditions in which the cross sectional area of the casting

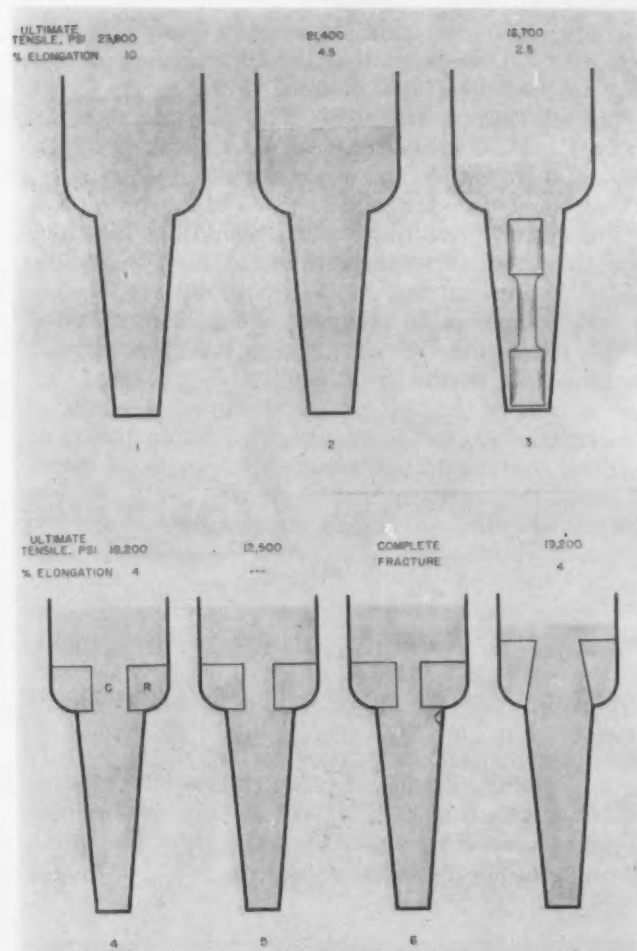


Fig. 2 — Effect of varying the feed metal supply on the physical properties of aluminum.

cavity immediately adjacent the exit aperture from the feed cavity was larger than the area of the sand aperture.

In test No. 4 a ring "R" provided with a passageway "C", having a diameter of 1 in. extending through, was inserted in the feed cavity, thereby reducing the area of the exit-aperture from the feed cavity. This resulted in the cross sectional area of the casting cavity immediately adjacent the exit aperture now being larger than the area of said aperture. The volume of the ring was approximately 4 cu in., so that when the feed cavity was filled to the limit indicated, the metal content in the feed cavity was approximately 13 cu in. Thus the ratio of feed cavity volume to casting volume was still in excess of 1 to 1. However, as shown in the above tabulation, there has been a serious deterioration in the physical characteristics of the metal which can be attributed only to the reduced area of the exit aperture.

Tests No. 5 and 6 showed the progressive deterioration which occurred as the size of the exit aperture was decreased further. In test No. 5 the conditions were precisely the same as in test No. 4 except that the dia. of the passageway "C" had been reduced to 0.75 in. As shown in the tabulation, the metal of the casting was virtually worthless since the tensile strength was extremely low and there was no measurable elongation.

In test No. 6 the conditions were precisely the same as in test No. 4 except that the dia. of the passage-way "C" had now been reduced to 0.5 in. As shown in the tabulation, the metal of the casting was virtually worthless as the tensile strength was extremely low and there was no measurable elongation.

Test No. 7 was designed to prove the deterioration of the casting, resulting from a condition in which successive transverse sections of the feed cavity immediately adjacent the casting cavity did not increase in area progressively away from the casting cavity. In this test a ring "R", having a tapered passage "C", was inserted in the feed cavity. The passage "C" had a dia. of 1.5 in. at the bottom, a width of 1 in. at the top, and a length of 1.5 in. In this case, the feed contained approximately 8.5 cu in. of metal, or about the same amount as in test No. 2. As you can see, the ultimate tensile strength and elongation figures of this casting were again lower than in case No. 1.

Summarizing the effect of the Parlanti Mould System, you will note the advantages of a mold giving a controlled ratio of heat transfer. It must also be accompanied by adequate feeding and the correct positioning of feed in order to obtain the very desirable higher strength figures in a casting.

As a typical example of the results of this system, a lever was cast in 195 alloy, an aluminum alloy containing 4 per cent copper. Figure 3 gives the physical properties of the casting.

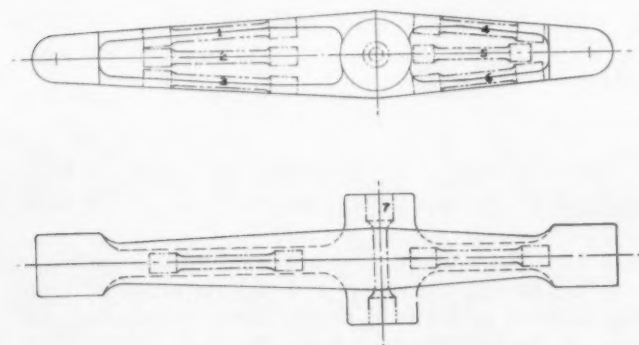


Fig. 3—Sketch of "lever" casting showing location of test bars cut from it for physical testing. Casting is 10-3/4 in. long. Results of tests are as follows:

Test bar	Ultimate tensile strength, psi	Elongation % in 1 inch
1	51,000	16
2	54,800	16
3	54,200	13
4	52,500	12
5	52,200	14
6	56,100	16
7	50,000	16

Test bar from	% in 2 in.	Yield strength, psi
Melt heat treated	47,100	27,400

MECHANICS OF THE SYSTEM

As the Parlanti Mould Process has evolved from the foundry's needs for lessening its existing variable conditions, it was quite natural that the mechanics of the process should utilize all methods known to the foundry.

The process employs three basic methods of mold manufacture: 1) making a pattern of the mold and 2) making a metal pattern and casting metal around it as though by the permanent mold method, or 3) machining directly from a billet.

Experience has proven that of these three, the sand technique is the least satisfactory because of porosity. There are, of course, other techniques which can be used—such as a combination of all three methods; or, in production, by making a series of permanent molds, one for each section of the mold, and by this means casting numbers of molds (called a maternal mold.)

What about cores in the process? These can be solid as in normal permanent mold methods or hollow for further increasing the rate of heat transfer. They can be extended and finned or, as in some cases, can be used to subdivide a heavy section. In other circumstances heavy gauge wire can be used. (These types of cores can be kept cool during the pouring operation or they can be, as in the case of casting steel, used as expendable cores.) With the normal type of core, the best means of production is to machine, or otherwise produce, a metal core box and then cast into it as many cores as may be required—again, a maternal mold.

There is yet another form of core—the type used for wave guide castings where smooth bore and accurate dimension is of paramount importance. This type of core can be used where no draft can be considered. This is arranged by machining a piece of heat-resisting or low-expansion iron. By carefully polishing this core and using care in vacuum dehydrating the surface, before its contact with molten metal, excellent surface definition can be obtained. The core is removed from the casting by a heat shock technique. Many castings have been made by this system. Surface finish of 16 microinches has been obtained and deviation of less than 0.00035 in. per in. has been measured.

The cores, when aluminum, are anodized the same as the molds. Anodizing may be done with any of the known electrolytes and suitable current density systems. The selection of these will depend on the type of alloy used for the molds. For the Parlanti Mould Process it has been found best to keep to one alloy for the molds. Primarily, the silicon series is used and of these the low expansion type of silicon alloy—12 per cent Si, 1.2 per cent Mg, 2.5 per cent Ni and 8 per cent Cu is preferable. For this metal we use the Eloxal process of anodizing—6 per cent oxalic acid in 15 per cent H₂SO₄. The anodized layer is essentially Al₂O₃, a 16-faceted crystal. It has a melting point exceeding 3700 F and a hardness of 9.4 on Moh's scale and is similar in structure to a ruby.

Jigs, fixtures and the mechanics of mold operation are primary considerations in the operation of the process. As will be seen later, the casting of some steels requires that the casting be removed and quenched as quickly as possible before the transformation temperature has been reached. For this, quick opening clamps are regularly used. When large production is required, methods such as conveyor line or rotary tables with multiple stations can be substituted.

It has been concluded erroneously that these anodized aluminum molds would distort with continued use. It is true that, if the design of the mold is not based on "sound knowledge" of the effects of heat conduction and radiation, this quite likely might be the case. Please note, however, that an aircraft engine which was used so successfully and extensively during the war, was fitted with aluminum pistons, as were many other types of engines. These pistons received an enormous thermal shock load many thousands of times per min. The crown of the pistons became very hot in spasms; but because they were correctly designed, they did not distort. In fact, they worked for many hours at very heavy loads.

It is assumed, therefore, that without the diligent care given to an aluminum piston, serious problems might have arisen. With the same constructive thinking in physics, as in the piston design, certain principles can be applied and the presence of warpage and/or distortion can be eliminated.

For this, it is important to first know the ratio and degree of heat conduction the metal of the mold in its cast form is capable of handling; Secondly, to know the variations in the volume of the casting itself, the cubic caloric content of the mass; and finally the requirements for balancing the projected cooling rate. One can readily see that the outer shape of any casting begins to design itself with the imposition of heat conduction on the mold. This heat contained in a mass can be calculated quite accurately by drawing a center line through the cast piece and noting the effect of the disposition of varying thicknesses, and the need for further outside adjustment of the radiating surface.

It must be quite apparent that, when talking of heat conduction and radiation, the sections thus involved must be at least equal in thickness to withstand the rate of the heat load imposed upon them. This, then, will help again to minimize any small amount of distortion which may be found within the mold.

By way of further illustration, a steel capstrip casting was made for the aircraft industry, and mold distortion was found in the first casting trials. The ends tended to rise and gave short dimensional life to the mold. By the insertion of thermocouples, the heat flow was measured along the length of the mold. By calculations based on these measurements four recesses (fins) were machined into the length of the mold. This extra surface area and reduction of thickness at the corners balanced the rate of heat conduction and radiation with the result that distortion was eliminated. Many further castings, in 4340 steel, were made with that particular mold. This same fin configuration was repeated in subsequent molds until the job was concluded.

Summarizing the mechanics of the Parlanti Mould Process, the molds are suited admirably to the parts where physical structure of the metal is of prime importance and close dimensions, such as are sought in lost wax or allied systems, are of secondary consideration. After the structural demands have been met, attention to fine tolerances, if required, can be given to the piece. (This is simply a matter of mechanical skill and application of known tool-room practices.) After prototyping to the designer's satisfaction,

molds can be produced by the permanent mold method, or by the die casting system, for parts or cores, and many thousands of parts can be made in a very short time. With careful control over metal melting and heat treatment, all the castings produced within inspection tolerances will meet the physical figures of the prototype.

APPLICATIONS

The Parlanti Mould Process is applicable to all light alloys, cast irons, and steels.

Light Alloys

The alloys in aluminum found best suited are those based on the 5 per cent Cu series (195). If the phase diagrams are followed and the cooling range



Fig. 4 — Typical aluminum castings made by the Parlanti process.



Fig. 5 — "Lever" casting showing the finished piece, casting with the header, and Parlanti Mould in background.

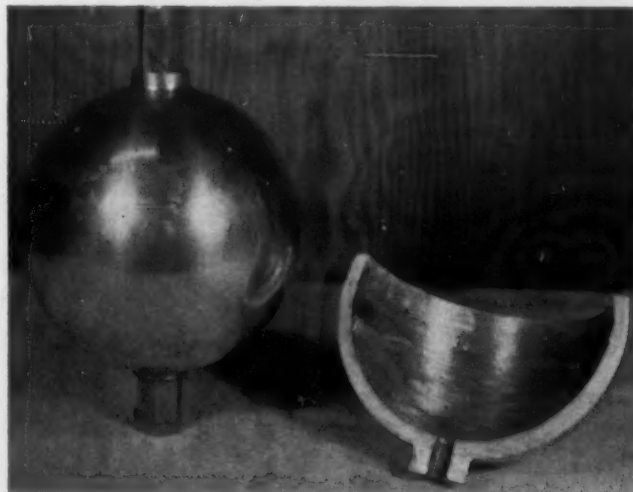


Fig. 6 — Hollow aluminum ball, alloy 195, with 3/8-in. wall thickness cast by the Parlanti process.



Fig. 7 — AZ91C magnesium turbine housing casting showing trimmed part, casting with header, and mold in background. Part in right foreground was machined to 1/8-in. thickness to prove soundness.

figured accurately, some quite excellent physical figures may be obtained. Figures of 35,000 psi ultimate tensile strength and 12 per cent elongation have been obtained in the as-cast condition. When heat treated and aged, values were raised to 55,000 psi ultimate tensile strength and 10-12 per cent elongation.

The heat treatment techniques normally quoted for these alloys must be changed in the Parlanti Mould Process. What is essentially produced by this process in the as-cast condition is a fine-grained and partially heat-treated structure with characteristics that will allow development of still better properties on further heat treatment. The heat treatment consists basically of shortening the time in the solution phase and lengthening that of the aging cycle.

The process is well suited also to most of the aluminum light alloy group designed for working at elevated temperatures. The aluminum alloys of the silicon family are not favored as highly for castings because they are difficult to control in production melting.

The process is especially adaptable to magnesium, and very interesting physical properties have been observed with this metal. Again, heat treatment times have to be changed. Under normal conditions in AZ91C, 4-6 per cent elongation was obtained easily in the as-cast condition.

Magnesium alloys respond satisfactorily in this process—including those for high temperature applications with zirconium, thorium, or other rare earth additions. The controlled cooling action prevents segregation or migration and agglomeration of the alloy additions.

In general, for both aluminum and magnesium melting, the procedures are the same as utilized in most foundries. The control of melting temperatures, the proper degassing, the checking with the Pfeiffer test, and the temperatures and techniques for pouring are of paramount importance. The quality of the metal and the way it is poured into the mold are factors which must be rigidly controlled in any foundry. The extra value of the anodized aluminum mold is seen after the metal has been poured into it.

Cast Iron

Either an easily machinable gray iron structure or a hard, white abrasion-resistant structure can be ob-

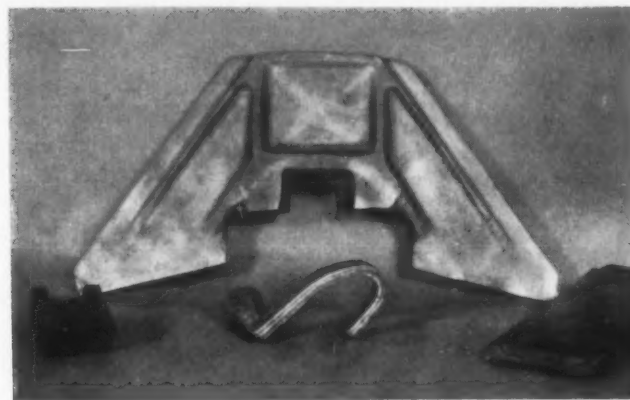


Fig. 8 — Four castings shown include: motor mount casting in 410 stainless (background); hook shaped piece of high temperature alloy bent as-cast; super hard blade for blast cleaner (right foreground); and casting from which expendable aluminum core was removed (left foreground).

tained by regulating the rate of heat transfer through the mold blocks.

Nodular irons are particularly suitable for this process, and some quite remarkable figures have been obtained.

Steel

Great care must be given to the design of steel casting in this process. Severe changes in section thickness must be watched in design. Attention must be given to correct fillet radii and tapers. Generally speaking, these variations should have generous tolerances.

Speaking of the suitability of steel to the Parlanti Mould Process, the following is quoted from a report of a metallurgist for a well-known company, who wrote after visiting our development foundry, "While watching a pouring of type 410 stainless steel in their experimental foundry, it was interesting to note that the red hot casting was taken from the mold less than 15 seconds after pouring was completed."

The capstrip of 4340 steel referred to earlier, was cast in the anodized mold. This casting was poured also at upwards of 3000 F and removed from the mold in about 20 seconds.

Copper Alloys

Very little work has been done on the copper alloys, and until these alloys have been tested in some detail, little can be said about the application of the process to them.

Vacuum Techniques

Vacuum techniques are used by the process both for melting and for casting. In producing high quality castings, the technique calls for the exclusion of air from the mold which is itself enclosed in a metal container connected separately to a vacuum pump. The container's top is sealed by a thin sheet of metal made from the same alloy to be cast into the mold. The mold is held to the underside of the sealing sheet by spring pressure. The runner box, or launder, is located on the top of the plate, and clamped down to form an airtight seal when the metal enters. As the metal is poured, the sealing sheet at the top ruptures at a prearranged striking point of the cast metal,

and allows the metal from the crucible to flow into the mold without admission of air.

Design

It is almost impossible to make specific statements about the design of castings for this process. Generally speaking, however, parts to be cast by the Parlanti Mould Process are designed more like forgings than sand castings. But with this method, more precision of detail and greater intricacy of shape will be obtained. Cores must have a minimum taper of 3 degrees. Parallel cores are possible. They do increase the cost of the casting because special provision must be made to permit core movement as the casting contracts on freezing. If the part is in cast iron, steel, or another metal with a melting point considerably higher than aluminum, a disposable aluminum core may be used.

It is most essential that re-entrant angles or sharp changes of sections be avoided as these not only produce resistance to normal contractions but also induce thermal gradients by virtue of the Leonard effect. The use of fillets at such points will not allow for more normal contraction by a streamlining effect, but will eliminate notch effects and equalize thermal gradients. Similarly, the location of heavy masses or sections of metal adjacent to thinner portions will give rise to thermal gradients producing internal stresses through unequal contraction in these parts of the castings. The introduction of members connecting parallel portions of the castings and the partitioning of castings into a number of compartments are design features which should be avoided, if possible, as free contraction of the castings' individual parts cannot occur under those limitations.

In all questions of design it is most important to repeat that adequate feeding of heavy sections be effected; otherwise, internal porosity in the form of piping or center line shrinkage will develop.

In summary, when the engineer, designer, and metallurgist work closely together to eliminate the design dangers mentioned above, the process will adequately meet all the needs for physical properties in a casting well above those obtainable at present standards.

FUTURE

As pointed out in this discussion, the Parlanti Mould Process is based on the premise, that by controlling the rate of heat transfer and satisfactorily feeding the casting mass with sufficient liquid metal until the casting requires no more metal for its contraction, a high quality casting of superior properties will result.

This, in effect, is not a new system but the further evolution of foundry techniques. This process has been used in the making of billets and ingots for quite some time. Why not apply it to a shape which more nearly approaches the designer's requirements for the finished product? Is that application logical or not? Is this method a step in the right direction? These questions are left with you to consider. This discussion has been an attempt to pass along to you some of the Parlanti "know-how", and to show you its varied applications and the problems it can solve in many metals.

What about new applications? The time is foreseen when all ingot before melting is subjected to vacuum techniques. The Parlanti Mould system of vacuum casting can then be enlarged in scope to a conveyor system of separate chambers.

The application of this system is visualized for titanium and molybdenum casting. These molds have been used successfully to accept molten metals at temperatures up to 3600 F. There is no reason to believe they would not be operable also for these valuable high temperature metals.

Several titanium castings have been poured into a Parlanti Mould. The surface of these castings was excellent, no contamination found and the mold was unaffected. The physical properties determined in preliminary tests indicate good metal. Even with the incomplete results obtained so far, the Parlanti Mould will provide a successfully reproducible method for some titanium castings.

It is predicted that the process will be used by metallurgists in the further study of phase diagrams of alloys to control the arrest point in phase development and not leave it to the more or less haphazard end results which are so frequently the case at present. In fact, the process will allow you to control the physics of alloy design to its very completion, giving the optimum results possible.

All this in the foreseeable future, in turn, must benefit the designer and so help him meet some of the modern requirements of high speeds and, consequently, high stresses. This factor becomes especially important for castings required to give high physical figures at high temperatures.

Again, you must understand, the Parlanti molds will not in themselves do all these things, but properly engineered, they will enable you to more nearly meet your needs.

The Parlanti Mould Process is not a universal cure-all to casting problems, but it is your tool to enable you to solve a number of them!

WRITTEN DISCUSSION IS SOLICITED

By

G. Otto*

This is the method used to arrive at die cost. Actual die costs are collected by our tool service department on a "Revise and Recondition Die Record" card illustrated in Fig. 1. In this form, normal cost covers those incurred through normal use such as

These two records are consolidated into one record referred to as "Summary of Maintenance and Die Cost Revision-Foundry", Fig. 3. These records are used to study the effect of die changes on the die per-

FORM 210-T REV. 1-5-54				REVISE & RECONDITION DIE RECORD				DRAWING NO.				
DATE	ORDER NO.	VENDOR	REVISE & RECONDITION	NO. PIECES RUN	FOREMAN, VENDOR LAST	NORMAL COST	REVISED COST	ABNORMAL COST	DIE REC.	MATERIAL COST	SEQ. IN	DIE
DRAWING NO.				LOCATION				DESCRIPTION				PART NO.
OPERATION NO.												

EXP. 10-1-55, 10-1-56, 10-1-57

Fig. 1—Actual die records are furnished from tool service department and cover costs incurred through normal use.

PART NO.	DIE NO.	DIE TYPE	TOTAL PARTS	GOOD PARTS PROD.

Fig. 2—Annual records are furnished by production department.

DIE NO.	PART NO.	YEAR	TOTAL COST	REVISION COST	GOOD PARTS	MAINTENANCE COST	COST PER GOOD PART COST

Fig. 3—Summary shows effect of die changes on performance.

formance. The normal maintenance cost per piece used by management to effect less expensive foundry operations.

In order to obtain what might be called "normal die life" several factors such as die maintenance, die lubricants, die material, mold coatings, etc., contribute greatly to die life.

The type of die maintenance which is the most repetitive is that due to soldering of aluminum to the steel die. It has been observed that the less the draft on dies, the more severe is the soldering. It is preferred to work with drafts of 3 deg or more on die casting dies. Dies with this large a draft would last much longer than some dies which have to be built with drafts of 1/2 deg.

DRAFT AFFECTS SOLDERING

The practice in removing soldered aluminum is to mechanically abrade the foreign aluminum and follow this with a polish. Recently experiments have been made with strong alkali cleaners. The indications here are that all aluminum is removed except for the iron rich layer next to the die. This has to be removed mechanically. The next most serious die maintenance problem is that of bending and breaking of ejector pins which are of a small size, as 1/8-in.

The practice for the last several years to specify S.A.E.-A.I.S.I. H-13 hot work tool steel for aluminum and zinc die casting dies. These dies are hardened to a Rockwell hardness of "C" 44-48. This seems to be almost an industry standard. However a cast iron material has been used on permanent molds.

Dissatisfaction with short life due to cracking of the mold prompted use of the H-13 die steel on a new design of casting which went into production about two years ago. Due to the general flat shape of the casting, it was possible to use forged shapes of steel to construct this particular mold rather than a cast-to-shape mold. This mold was not hardened. This hot work steel has lasted twice as long as the cast iron mold and is still running. It is intended to use cast-to-shape hot work steel as a replacement for cast-to-shape cast iron molds.

DIE WELDING REPAIR

For die cast die welding repair, stainless steel (300 series) rod is used. This rod was selected for two reasons: its compatability with the parent metal and the fact that it will work harden to give good wear resistant properties.

There is a long way to go in the die welding program and currently work is being done on die pre-heat facilities and the use of welding rod of the same composition as the die itself. The major trouble with welded dies is the gas porosity which forms in the bead. When this happens, nothing can be done but grind the defect out and reweld. Fig. 4 shows a photomicrograph of the weld-parent metal interface.

Some time ago a die designed for aluminum was converted to zinc. In order to obtain the proper weight zinc casting it was necessary to build up the male portion of the die with 1/32-in. chromium plating.

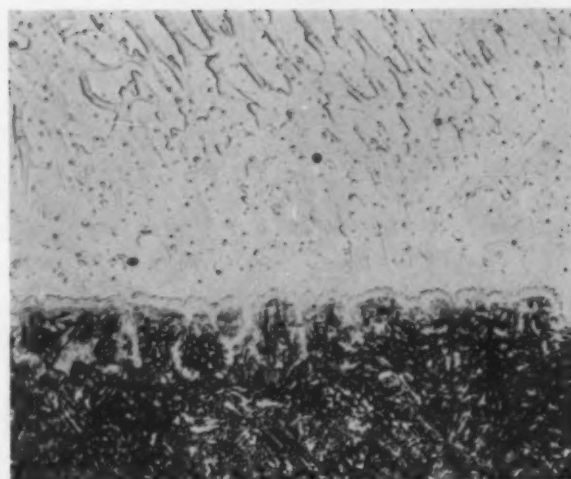


Fig. 4—Photomicrograph of weldment interface $\times 500$.

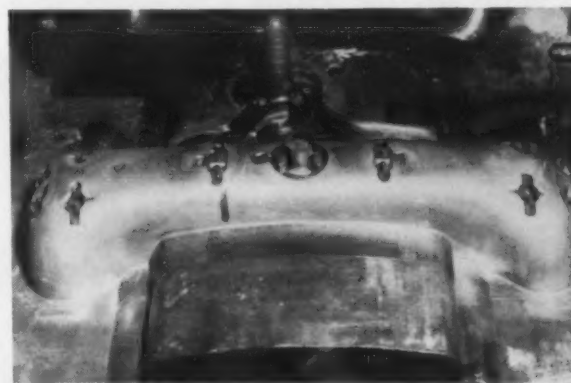


Fig. 5—Chromium plated die repaired with stainless rod.

Satisfactory parts have been produced from this die. However, some plate chipping did occur in drag areas and it was found necessary to repair the die by welding. Stainless steel rod was again used and the results have been surprisingly satisfactory, Fig. 5.

WATER SPRAYING ADDS LIFE

The mold coating and die lubricants used for permanent mold work and die cast work have a very definite effect on mold life. Actually, coatings and lubricants are used for ease of casting release and to extend tool life. On permanent molds, a finite amount of material is built up on the molds to prevent actual contact of molten aluminum on the mold material. The mold coating practice for the last several years is to use proprietary materials which are diluted with water. A coated mold is shown in Fig. 6. This is the permanent mold made from H-13 die steel.

For aluminum die casting work, proprietary compounds, diluted with a petroleum product, are used for a die lubricant. In addition to the conventional die lubricant just mentioned, certain dies are sprayed with water to cool the die and reduce soldering. This technique is used primarily where, due to die construction, it is not possible to effect die cooling with internal cooling lines.

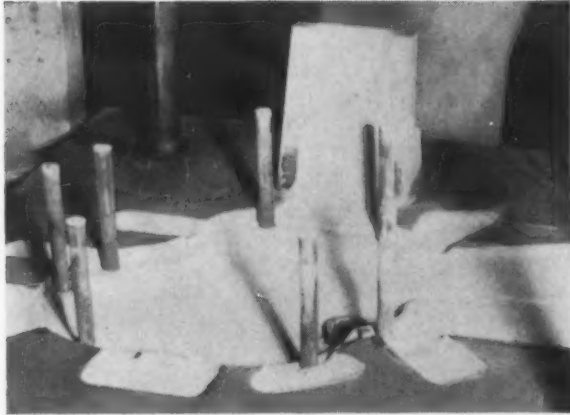


Fig. 6—Application of coating to aluminum permanent molds eases casting release and extends tool life.

The temperature of the die plays a very important part of die life. The practice is to attempt to hold an aluminum die casting die at 400 F (204 C). If the die runs hotter, serious soldering is encountered. It is felt that this practice of water spraying contributes a great deal to reduced maintenance costs and improved die life. This operation is shown in Fig. 7.

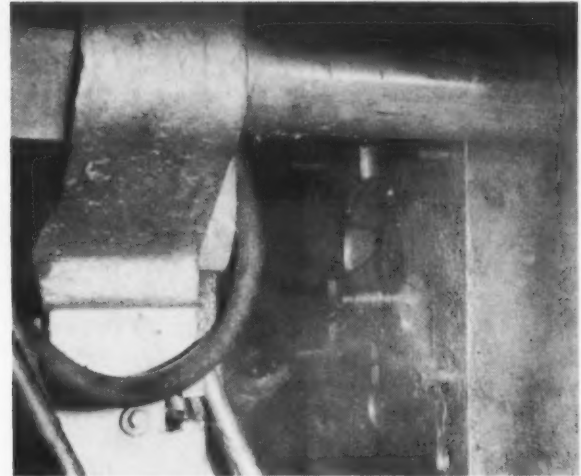


Fig. 7—Water spraying aids in controlling die temperatures, resulting in longer die life and reduced maintenance costs.

Due to the nature of the company's product, millions of one type of casting are produced before design changes are made. It is anticipated that more than 250,000 good aluminum castings can be made per cavity and more than 500,000 good zinc castings per cavity.

This paper has been approved for presentation at the 62d Annual Meeting of the American Foundrymen's Society, to be held in Cleveland, May 19-23, 1958. The Society reserves all rights for publication either prior to or subsequent to presentation, and is not responsible for statements or opinions advanced herein.

WRITTEN DISCUSSION IS SOLICITED

FACTORS INFLUENCING THE RESISTANCE OF STEEL CASTINGS TO HIGH STRESS ABRASION

By

T. E. Norman*

ABSTRACT

The abrasion resistance of heavy section steel castings has been studied by service tests on ball mill liners and by a short-time test procedure which correlates well with the results on actual liners. The short-time test has made it possible to determine the effects of many more variables in composition, structure and heat treatment than could ever be determined by many years of testing on actual liners.

Martensitic, pearlitic and austenitic steels, mainly with high carbon contents, have been studied. In general the martensitic steels had better abrasion resistance than the pearlitic steels. A fairly wide range of abrasion factors is possible for each microstructure, depending on such factors as carbon content, austenitizing temperature, tempering temperature, alloy content and, for pearlite, the fineness and resultant hardness of the pearlitic structure.

The austenitic steels gave the greatest range in abrasion factors. This was dependent largely upon their composition. Possibilities appear to exist for "lean-alloy" high carbon austenites capable of showing substantially better abrasion resistance than the conventional 12 per cent manganese, austenitic steel.

The abrasion factors for the various steels which were studied apply specifically to the operating conditions in the primary grinding mills at Climax. Data from grinding tests on relatively pure minerals of different hardness indicate that the range in abrasion factors will normally be greater when grinding the softer minerals than when grinding quartz or other very hard minerals.

INTRODUCTION

Steel castings are frequently used in applications where parts rub together in a gritty environment to produce a form of wear known as "high stress" abrasion. This type of wear has been discussed and clearly defined by Avery.¹ Cast steel suitable for such applications normally must have a combination of good abrasion resistance, a certain degree of toughness, and adaptability to production and heat treatment in heavy sections. Cost and availability are also important factors in the selection of a steel for these castings.

Grinding mill liners constitute one of the more important applications for steel castings which are used

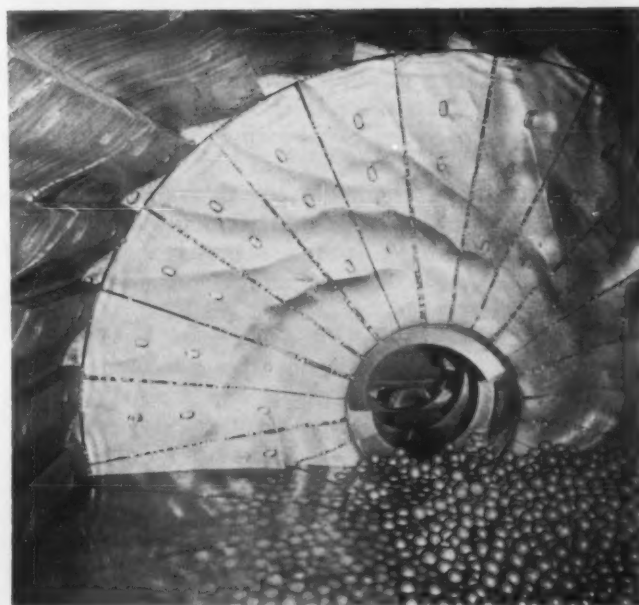


Fig. 1—Interior view of a 13-ft diameter ball mill showing partially worn end and shell liners.

under conditions of high stress abrasion. Most grinding of ores and non-metallic minerals is done in large rotating cylindrical mills containing a charge of balls or steel rods which pulverize the crushed ore by tumbling action. Severe abrasion, accompanied by varying degrees of impact, occurs in these mills.

Figure 1 shows a view of the interior of a large rotary type grinding mill. This shows the "end" and "shell" liners in place together with evidence of their typical wear pattern. A set of liners in mills of this type will wear out in a period ranging from as little as two months up to several years. This service is governed by three major factors: (a) operating conditions, which includes type of material being ground; (b) liner design; and (c) abrasion resistance of the liner material.

This paper deals with evaluation of the abrasion resistance of various types of cast steels which have been or might be used in grinding mill liners. The

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principal basis for this study has been a program of evaluation on various liner materials which have been tested in the primary ball mills at Climax, Colo., over the past 20 years. Over 500 sets of liners have been worn out during this period.

ABRASIVE WEAR IN BALL AND ROD MILLS

The abrasive forces in ball and rod mills are largely of the "high stress" type. This high stress wear occurs when mineral particles are crushed between two surfaces. Quartz and silicate minerals are the most common materials which produce the wear resulting from these abrasive forces.

Some comprehension of the unit stresses involved can be obtained from the fact that quartz is capable of indenting or scratching the hardest types of steel. The unit stresses are therefore probably above 300,000 psi. Such high stresses are, of course, confined to very small individual areas on the wearing surfaces at any one time. They are, however, apparently capable of causing micro-spalling or fracturing of brittle constituents, such as coarse carbides, which may exist in the structure of some wear resistant alloys.

High stress abrasion also occurs in industrial applications other than grinding mills. This is particularly true in applications where dirt and grit are unavoidably trapped between two bearing surfaces, such as in conveyor chains and sprockets, open gears and exposed parts of earthmoving equipment. The results obtained in grinding mills may, therefore, show substantial correlation with the wear which occurs in many of these other applications.

TIME ELEMENTS IN WEAR-TESTING MATERIALS

A minimum period of several years is normally required to evaluate the merits of any one material for grinding mill liners. To speed up this investigation, the author has developed a "short-time" wear test in which liner materials are tested as large-diameter, marked grinding balls in the same commercial mills which use the actual liners.

With this test, numerous variables in composition, structure or heat treatment can be compared in a single test, assuring that each test material is exposed to identical abrasive and impact conditions. This has permitted a study and comparison of many more variables in materials than could ever possibly be studied by full scale liner tests. This short time test has shown excellent correlation with full scale liner tests on those materials which have been studied by both procedures. The short time test has been and should continue to be especially useful in studying the effects of single variables in a particular type of material. It can be completed within a matter of a few weeks, and will yield more comparative data than could be obtained from many years of testing on actual liners.

PROCEDURE FOR SHORT-TIME WEAR TEST

The test procedure which was used for liner materials is rather similar to a procedure developed and described² for grinding balls. The principal difference is that for liner materials, large size balls (usually 5-in. diameter) are used so that their cooling rates during solidification and heat treatment are such that

they will develop structures similar to those in the heavy sections of liners having the same composition and treatment.

Normally a group of three to four identical balls having an original diameter of 5 in. are made up to represent each specific material or each single variable in a type of material. In most cases the wear rates on all balls in the same group are so closely identical that a group of two balls would be sufficient to provide reliable results.

After all balls within a group have received the desired heat treatment, they are given an identification mark consisting of two narrow notches about 3/8-in. deep, which are cut into their surface at definite relative positions to each other. The notches are cut with an abrasive wheel and are either 1/8-in. or 1/16-in. wide. By placing the two notches at a definite spacing to each other and by using a combination of 1/8-in. and 1/16-in. wide notches, a large number of distinctive identification marks are possible. Spark testing may also be used as a means of further identification. As many as 30 different groups, each with a different identification, have been run at one time by this procedure.

After marking, all of the test groups are "worn-in" by charging them all at one time into an operating ball mill. The test balls seldom constitute over 1 per cent of the total weight of ball charge in the mill. They are run in this mill for a sufficient length of time to remove about 1/8-in. of metal from their surface. In the Climax mills this requires about eight days. The wear-in serves to remove decarburization and other defects which might exist on the original surface of the balls.

At the end of the wear-in, all of the marked test balls are recovered at one time from the rest of the ball charge. This is done during a normal shut-down period (usually at a week-end). Since the test balls are larger than the rest of the balls in the mill charge, they are easily found within an hour or two. Their identification marks are then cut deeper if necessary, and each ball is individually weighed for the subsequent wear test.

The wear test consists of running the groups of marked and weighed balls, including a group representing a "standard" material, in an operating mill for a sufficient length of time to remove from 1/8-in. to 1/4-in. of metal from their surfaces. The test balls are all charged into the mill at one time and removed at one time so that all are exposed to identical operating conditions.

Following this they are re-weighed individually, the Rockwell "C" hardness on their worn surface is determined, and their surface area is calculated from their specific gravities and weights. (Specific gravity is determined by weighing the balls in air and in water.) Other wearing characteristics of the balls, such as spalling or peening, if any, at the identification marks are noted. Occasionally, if brittle materials are being tested, the balls will spall or break in service. In this case the wear test also serves as an impact test.

The basis on which wear rates are compared is an important consideration. Carefully-run tests at Climax and in other mills on marked balls of identical composition and structure, but of different size and weight,

have indicated that balls wear (lose weight) in direct proportion to their surface area. This is equivalent to saying that they lose diameter at a constant rate, irrespective of their actual diameter. This has been confirmed by a number of investigators^{2,3,4,5}. Consequently, all of the wear rates on test balls are based on loss of weight per unit of surface area.

This figure is compared to the loss per unit of area on the group of standard or reference balls included in each test to provide an "abrasion factor". Abrasion factors are always relative to a nominally assigned factor of 100 for the "standard" material. For instance, on a typical wear test, the "standard" material lost 180.8 gr per 100 sq cm. The balls in group "B" lost 206.5 gr per 100 sq cm. Consequently, the abrasion factor for the group "B" balls was $206.5/180.8 \times 100 = 114.2$. In this paper these abrasion factors are reported to the nearest whole number.

Some explanation of how ball surface areas are calculated may be in order. For calculation purposes each ball is assumed to be a perfect sphere. The specific gravity of each ball is determined as previously described, and from this value and the known weight of the ball, its volume and surface area may be easily calculated. For convenience, the author has made charts which plot surface area against weight (a straight line function) for each specific gravity commonly encountered in the test balls. This saves considerable calculation when large numbers of balls are run on a single test.

The area used in the wear rate calculation also deserves some comment. Theoretically this should be the average area of each ball during the wear test. However, for comparative purposes it is permissible and simpler to use the area of each ball at either the beginning or end of the test, since the change in area is relatively small and no significant difference in the resultant abrasion factor is produced by this procedure.

The choice of a suitable material for the comparative standard is important since this material must be consistently reproducible and must serve in many tests which may be spaced years apart. For the tests

on 5-in. balls, the author has used a high carbon, fully hardened martensitic type of steel, since such a composition and structure is easily reproduced and has shown very consistent and uniform wear rates.

To fully harden a 5-in. ball of this type by commercial procedures, a substantial alloy content is necessary in the composition. The actual material used for the 5-in. ball tests is a high-carbon air-hardening composition containing nominally 1.0 per cent carbon, 0.8 per cent manganese, 6.0 per cent chromium and 1.0 per cent molybdenum. It is hardened by austenitizing at 1900 F followed by an air quench to room temperature and a stress relief at 400 F.

In the earlier tests which were run to evaluate 3-in. balls², a 0.80 per cent carbon, 0.60 per cent manganese, 0.20-0.30 per cent molybdenum type composition, fully hardened by austenitizing at 1550 F and water quenching, was used as the standard. This use of two "standards" was made necessary by the size change from 3-in. to 5-in. balls and by other practical considerations. The material used in this 3-in. ball test shows an abrasion factor of 110 when compared to the factor of 100 for the air hardening high carbon steel used as a standard in the 5-in. ball tests at Climax. This should be kept in mind when studying the abrasion factors listed in Table 2.

CORRELATION BETWEEN RELATIVE WEAR RATES

In the course of wearing out over 500 sets of ball-mill liners in the primary grinding mills at Climax, many different materials have been investigated. On the five most commonly used cast steel types, the averaged performance data has been compiled from the sets of liners of each specific design run under each specific operating condition. This has provided a reliable set of relative wear rates for each of these type compositions. These are given in Table 1, together with the abrasion factors established by the short-time "marked-ball" tests on these same materials in the same mills.

The relative wear rates for the 5-in. balls, on two or more tests, normally do not vary more than 1 per cent from the values given in Table 1. Quite under-

TABLE 1 — RELATIVE WEAR RATES OF LINER STEELS
WHEN TESTED BOTH AS LINERS AND AS LARGE GRINDING BALLS AT CLIMAX

Item No.	Description and Heat Treatment	Typical Composition — %				Hardness* Rc	Relative Wear Rates	
		C	Mn	Cr	Mo		5-in. Balls	Mill Liners
1	Martensitic 1% carbon Cr-Mo steel air-quenched from 1900 F. Tempered 400 F	1.0	0.8	6.0	1.0	54-58	100**	100**
2	Martensitic 0.7% carbon Cr-Mo steel marquenched in salt. Tempered 500 F	0.7	1.0	1.5	0.5	56-61	111	107-115
3	Martensitic 0.7% carbon Cr-Mo steel marquenched in salt. Tempered 900 F	0.7	1.0	1.5	0.5	49-52	126	120-130
4	Pearlitic 0.8% carbon Cr-Mo steel air-cooled from 1800 F. Tempered 1000 F	0.8	0.8	2.5	0.4	38-41	127	122-127
5	Austenitic manganese steel water-quenched from 1900 F	1.2	12.0	...	...	47-52	140	140-145

*This is the hardness range on the worn surface of the test balls. Hardnesses below this cold-worked surface are normally lower than those given above. The structure and hardness of the liners corresponds closely to that of the balls.

**This is a nominally assigned factor. Relative wear rates of the other materials are based on this factor of 100 for item 1.

standably, this close consistency is not obtained from actual sets of liners of the same type material, where minor variations in production or conditions of service are probably responsible for the maximum spread of about 10 per cent which is obtained between the wear rates of individual sets in the Climax mills. However, when the results from many sets of a specific material, run in one condition of service, show a maximum spread of only 10 per cent, it is statistically true that a considerable degree of confidence can be placed in the average of these results and in the relative wear rates based on these averages.

In most cases the relative wear rates on the liners listed in Table 1 have been compared under several conditions of service. These include service as shell liners and end liners, service in several different liner designs, and service at three different mill rotational speeds. Since the averaged relative wear rates of the liners vary somewhat in each of these conditions of service, it is necessary to report these as a range. In all cases the rates were within the ranges indicated in Table 1.

The correlation between the relative wear rates established by the 5-in. ball tests and the relative wear rates on actual liners is extremely good, as can be seen from Table 1. Actually this should be expected. Under the conditions of high-stress grinding abrasion, the forces causing abrasion between balls contacting each other should be practically the same as the forces acting between the balls and the wearing surface of the liners. The character and magnitude of these forces are probably determined largely by the hardness and crushing strength of the minerals being ground, which in turn means that these abrasive forces should act similarly and with equal magnitude on all wearing surfaces within the mill.

VARIABLES INFLUENCING WEAR RATES

The microstructure of a steel is a dominant factor influencing its wear resistance. It is, therefore, necessary to classify the steels according to their microstructure before the true effects of variations in composition, treatment or mechanical properties can be properly evaluated. The results and discussion on the effects of certain variables influencing wear will therefore be divided into three microstructural classifications: 1) martensitic steels, 2) pearlitic steels, and 3) austenitic steels.

Effect of Carbon Content in Martensitic Steels (1-a)

Figure 2 shows the relative wear rates obtained from a series of low-alloy steels of varying carbon content. Each composition was suitably heat treated to develop a "fully hardened" martensitic type of structure, which of course necessarily includes structures consisting of martensite plus retained austenite. To develop "full hardening", liquid quenching treatments were used on all groups.

The abrasion factors shown in Fig. 2 are relative to the nominally assigned factor of 100 for our standard reference material, which is a 1.0 per cent carbon, 6.0 per cent chromium, 1.0 per cent molybdenum composition, air quenched from 1900 F to develop a structure of spheroidized carbides in a fine-grained martensitic matrix.

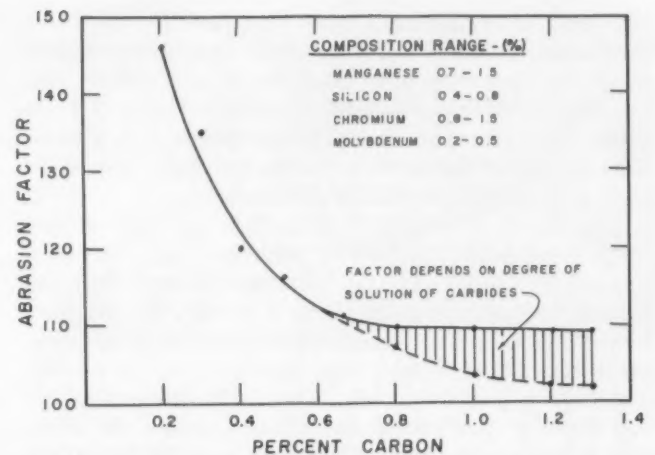


Fig. 2—Influence of carbon content on the wear rates of martensitic cast steels.

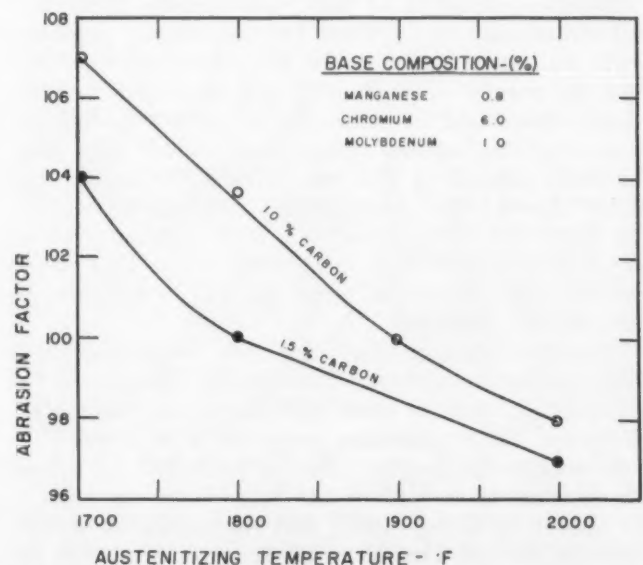


Fig. 3—Influence of austenitizing temperature on the wear rates of two martensitic cast steels.

It may be seen from Fig. 2 that the abrasion resistance of martensite improves at a fairly rapid rate up to about 0.7 per cent carbon. Further increases in carbon content tend to become less effective. This is to some extent dependent on the degree of solution of the pro-eutectoid carbides in the structure. In the high-carbon steels, those which have most complete solution of pro-eutectoid carbides normally have shown the best wear resistance.

While the trend shown in Fig. 2 probably applies in all grinding operations, it should be emphasized that the specific abrasion factors shown apply only to the primary grinding mills at Climax where the principal abrasive minerals are quartz and feldspar, quartz predominating. A limited number of tests run in other milling operations indicate that where softer ores or minerals are being ground, the use of carbon contents over 0.70 per cent is much more effective in improving abrasion resistance.

Effect of Austenitizing Temperature (1-b)

As is indicated by Fig. 2, steels with over 0.70 per cent carbon will show best abrasion resistance when

their pro-eutectoid carbides are in solution. The solution of these carbides is a function of the austenitizing temperature used during heat treatment. This is indicated quantitatively in Fig. 3 for the 6.0 per cent chromium, 1.0 per cent molybdenum compositions containing 1.0 and 1.5 per cent carbon respectively.

While Fig. 3 indicates that high austenitizing temperatures produce best abrasion resistance, it should be recognized that these high austenitizing temperatures also produce a high percentage of retained austenite of a metastable type in these 6.0 per cent chromium steels. Also, as soon as most of the finely disseminated spheroidized carbides in the steel are dissolved, substantial grain growth occurs. The combined result is a structure which has lowered impact resistance and a tendency to spall in service. This has also been observed in tests at Climax on numerous other groups of high-carbon martensitic steel balls.

For the 1.0 per cent carbon, 6.0 per cent chromium, 1.0 per cent molybdenum composition, the best compromise in austenitizing temperature appears to be in the range 1800-1900 F. Balls air-quenched from 2000 F showed a tendency to spall slightly at their identification marks, while balls quenched from 1700 F showed a substantially faster wear rate. Also, it would be difficult to completely suppress pearlite formation in the heavy sections of actual liners quenched from as low a temperature as 1700 F.

Effect of Tempering Martensite on Abrasion Resistance(1-c)

The use of tempering temperatures up to 400 F on the high-carbon martensitic steels visibly improved their resistance to spalling and breakage without measurably lowering their wear resistance, even though a slight drop in hardness often was evident. This statement applies to both the liner materials which were studied as marked 5-in. balls and to the grinding ball materials which were studied mainly as marked 3-in. balls. Consequently, practically all martensitic steels (and irons) have been given a 400 F temper for relief of residual stresses. Actual liners of the martensitic type are now all tempered at either 400 F or 500 F for stress relief.

When the high-carbon martensitic steels are tempered at temperatures above about 800 F, there is a substantial improvement in their toughness; but this is accompanied by a rather serious loss in abrasion resistance. This is illustrated by comparing items 2 and 3 in Table 1. In spite of the fact that the martensitic Cr-Mo steel tempered at 900 F still has relatively high hardness, its wear resistance is only slightly better than a high-carbon pearlitic steel at a substantially lower hardness.

When high carbon martensite, tempered between 1000 F and 1200 F, was compared to a pearlitic steel having the same composition and hardness, the pearlitic structure showed definitely better abrasion resistance than the tempered martensite. This has been most frequently observed in our tests on 3-in. balls, where materials for grinding balls studied.² There has been little incentive, therefore, to do further investigation on martensitic liner steels tempered at the higher temperature levels, since this appeared to be a field of application most adequately served by the pearlitic types of high-carbon Cr-Mo steels.

Effect of Alloying Elements (1-d)

To produce a martensitic structure in a heavy-section casting, the steel must have high hardenability, which in turn requires the use of alloying elements. The minimum alloy requirements depend principally on the austenitizing temperature and the speed of quenching during heat treatment. Further alloy additions over this minimum have some interesting effects on the abrasion resistance of the steel. These appear to be closely associated to the austenite-retaining characteristics of each alloying element.

It is well known that manganese, nickel and chromium tend to increase the retained austenite content of "martensitic" structures. They are particularly effective in high-carbon steels. For instance, in a 1.0 per cent carbon steel, practically complete austenite retention at room temperature can be achieved when the manganese content exceeds about 4.5 per cent, or when the nickel content exceeds about 10 per cent, or when the chromium content exceeds about 5.0 per cent. The combined effects of two or more of these elements are proportionately additive, according to published data.

Carbon, in solution, is undoubtedly the most potent element in retaining austenite, though its effect in this respect is limited by the difficulty of keeping it in solution in amounts over about 1.40 per cent.

When the manganese content of a low-alloy martensite, containing 1.0-1.2 per cent carbon, was increased, a definite loss in abrasion resistance was experienced. This is illustrated in Table 2.

Nickel is another austenite-retaining element which behaves similarly to manganese in the way it tends to injure the abrasion resistance of martensite-austenite structures. Nickel additions do not appear to be as potent as manganese in this respect, though more data on the high-carbon nickel steels are needed before quantitative data can be reported. In the nickel steels studied to date, the full effect of the nickel contents has been partially obscured by the presence of chromium or other alloying elements. However,

TABLE 2 - ABRASION RESISTANCE OF 1.0-1.2 PER CENT CARBON MARTENSITE-AUSTENITE STRUCTURES WITH VARIOUS MANGANESE CONTENTS

Item No.	C	Composition, %		Mo	Austenitizing Temp, F	Av. Hardness on Worn-Surface, Rc	Abrasion Factor
		Mn	Cr				
1	1.0	0.8	1.8	0.4	1750	67	105
2	1.0	1.3	3.0	1.0	1900	58	101
3	1.0	2.5	1.0	0.5	1900	54	107
4*	1.0	5.0	...	...	1900	49	124
5*	1.2	11.6	...	...	1900	49	138
6*	1.2	13.3	...	...	1900	49	141

*Items 4, 5 and 6 were fully austenitic.

the qualitative effect of nickel on the retained austenite in both the martensitic steels and martensitic irons is quite apparent whenever nickel contents exceed 3-4 per cent.

Chromium, when in solution in a high-carbon steel, is a strong austenite retainer⁶. This retained austenite in the high-chromium steels has definitely improved the abrasion resistance of high-carbon martensitic structures. This is illustrated in Fig. 3 for the 6 per cent chromium steels. The steels in Fig. 3 with the higher austenitizing temperatures have correspondingly greater amounts of chromium and carbon in solution. This produces greater amounts of retained austenite, which in turn results in improved abrasion resistance.

The effect of chromium in this austenite, therefore, is opposite to that of manganese or nickel. This conclusion is supported by the good abrasion resistance obtained on high-chromium martensitic white irons which, in their as-cast condition, also tend to have high percentages of retained austenite in their matrix.

Molybdenum was used in relatively small quantities in combination with other alloying elements in the steels investigated. Its principal function here was to suppress carbide precipitation and transformation to pearlite during the cooling or quenching of these steels. Molybdenum is not believed to be a strong austenite retainer. Any effect which it might have had in this respect when added in quantities up to 1.0 per cent is obscured by the other alloying elements which were present.

Martensitic Steels and Martensitic White Irons (1-e)

In those grinding mills where impact conditions are not too severe, the martensitic types of white iron may be used successfully. A comparison of the relative abrasion resistance of several commercially available grades of martensitic steel and white iron is therefore of interest. The results of our tests on a

number of representative types of both of these materials, when tested as 5-in. marked balls in the primary mills at Climax, are given in Table 3. The various materials are listed in order of relative abrasion resistance.

While the white iron represented by item 1 in Table 3 is the most wear-resistant material tested to date, this must be balanced against its relatively high alloy cost. With the exception of item 1, the primary carbides present in the other white irons do not appear to have contributed much to their abrasion resistance in this service. Under these circumstances, the high-carbon martensitic cast steels compare favorably to the martensitic white irons.

Characteristics of Pearlitic Steels (2-a)

The pearlitic types of steel, such as item 4 in Table 1, have a combination of toughness, moderate alloy cost, and simple heat treatment which have made them a useful and popular material for grinding mill liners and other abrasion-resistant castings. They have generally been made with carbon contents ranging from 0.50-1.20 per cent, together with sufficient alloy content to produce a fine and relatively hard pearlitic structure. Their heat treatment generally consists of a simple normalize and temper, or in some cases the liners have been used quite successfully in their as-cast condition.

In considering the variables influencing the performance of pearlitic steels, it must be recognized that for any given carbon content, the pearlitic structure can have variable properties ranging from a relatively soft material with a coarse lamellar structure to a relatively hard material with a correspondingly fine lamellar structure. In addition, the pearlitic structure may be further complicated by the presence of pro-eutectoid carbides or ferrite which have an influence on their wear resistance. Because the variables influencing the properties of pearlite are closely inter-

TABLE 3 — COMPARISON OF SOME MARTENSITIC STEELS AND MARTENSITIC WHITE IRONS IN CLIMAX BALL MILLS

Item No.	Description and Heat Treatment	Composition — %						Hardness*		Abrasion Factor
		C	Mn	Si	Cr	Mo	Ni	Rc1	Rc2	
1	Martensitic Cr-Mo white iron air-cooled from 1950 F	2.8	1.0	0.6	15.0	3.0	..	54	66	89
2	Martensitic high-Cr white iron air-cooled from 2000 F	2.7	1.0	0.6	26.0	..	..	53	64	98
3	Martensitic Cr-Mo steel air-quenched from 1900 F, tempered 400 F	1.0	0.8	0.6	6.0	1.0	..	49	55	100 (Std)
4	Chill-cast Ni-Cr-Mo white iron cast, cooled in sand, tempered 425 F	3.2	0.7	0.5	2.0	1.0	3.0	..	59	107
5	Sand-cast Ni-Cr white iron sand-cast, cooled in molds, tempered 425 F	3.2	0.6	0.5	2.0	..	4.0	53	60	109
6	Martensitic Cr-Mo steel marquenched in salt, Tempered 500 F	0.7	1.0	1.0	1.5	0.5	..	55	58	111
7	Chill-cast Ni-Cr white iron cast, cooled in sand, tempered 425 F	3.0	0.5	0.4	2.1	..	4.5	..	55	116
8	Martensitic Cr-Mo steel water-quenched and tempered 400 F	0.4	1.5	0.4	0.8	0.5	..	48	55	120

*Hardness Rc1 represents the average hardness about 1/8-in. below the original surface of the balls prior to the wear-in and wear test. Hardness Rc2 is the average Rc hardness on the worn surface of the balls after the wear test. It reflects the effect of cold-work hardening at this surface.

related, it is often difficult to accurately evaluate the effect of a single variable. This in turn makes it difficult to plot the results graphically.

Effect of Carbon in Pearlitic Structures (2-b)

Carbon ranges between 0.50 and about 1.40 per cent were studied. Practically all of these studies have been run on low-alloy compositions in which up to about 3.0 per cent chromium and 0.30-0.50 per cent molybdenum were used as the principal alloying elements to aid in the development of a fine pearlitic structure in these heavy-section, air-quenched castings.

Hardness of these castings was in the range of 35-42 Rc. In general their abrasion resistance improved as their carbon content was increased up to about 1.0 per cent. Between 1.0-1.4 per cent carbon there was little, if any, improvement in abrasion resistance. This is probably due to the fact that carbon in excess of about 1.0 per cent practically all precipitates as grain-boundary carbides during the relatively slow cooling of these heavy-section, air-cooled castings. These grain-boundary carbides did not improve, and in some cases appeared to lower the abrasion resistance of the steel. They also lower the toughness of the steel.

Effect of Hardness (2-c)

For a given composition and austenitizing temperature during heat treatment, the abrasion resistance of pearlite increased in direct proportion to its hardness. High-carbon Cr-Mo steel compositions will produce pearlites with hardnesses up to about 50 Rc in 3-in. balls, but in 5-in. balls and heavy section liners, the practical limit is about 44 Rc. If attempts are made to produce pearlite harder than this in heavy sections, by the use of increased quenching rates or higher alloy contents, the result is usually a mixed structure consisting of pearlite, bainite, martensite and possibly retained austenite. Such mixed structures may lack sufficient toughness for the application in question.

Effect of Tempering (2-d)

The high-carbon Cr-Mo pearlitic steels showed no measurable loss in abrasion resistance when tempered up to about 900-1000 F. When tempered at 1100-1200 F, however, they showed a loss in both hardness and abrasion resistance, though in the few examples which were studied, this loss was relatively small. The higher tempering temperatures will normally improve the toughness of the steel and may be desirable for certain applications.

As-Cast versus Normalized Pearlitic Steels (2-e)

High-carbon pearlitic steel liners can be used successfully in many mills in their as-cast, sand-cooled condition. This has included the ball mills at Climax. In this as-cast condition, pearlitic steel liners with a hardness of 31-35 Rc showed equal or slightly better abrasion resistance than normalized pearlitic steel of the same composition with a hardness of about 37-40 Rc. There is some risk involved, however, in the use of as-cast liners. If they contain light sections, or if

they are shaken out of their sand molds too soon, they may develop an undesirable structure consisting of coarse-grained martensite and retained austenite, which is relatively brittle in its as-cast condition. For consistency of properties, a normalizing treatment appears to be preferable for most pearlitic steel liners.

Abrasion Resistance of Pearlite and Bainite (2-f)

By using austempering treatments, a number of Cr-Mo steel liner compositions have been transformed to bainite and tested both as 5-in. balls and as actual liners. These bainitic steels had a hardness range of 47-52 Rc, but even at this high hardness, they did not show as good abrasion resistance as the same compositions transformed to pearlite with a hardness of 38-42 Rc. These results are supported by similar studies which we have run on 3-in. balls. In addition, actual liners made with bainitic structures have shown a tendency to crack and break in service. This may be due to alloy segregation in heavy sections and resultant incomplete transformation. It appears, therefore, that pearlitic structures in the 35-44 Rc hardness range are definitely superior to bainite for grinding mill liners.

Austenitic Steels (3-a)

While the well-known 1.2 per cent carbon, 12 per cent manganese Hadfield type of austenitic steel has been extensively used for grinding mill liners, it is now being largely displaced by the more abrasion-resistant pearlitic and martensitic types of steel or by the martensitic white irons. The inherently good toughness of an austenitic steel is a desirable though usually unnecessary property for these liners.

From the data in Tables 1 and 3, it would appear that if an austenitic steel with reasonable alloy cost and an abrasion factor of about 110 or less could be developed, it should have attractive commercial possibilities. The combination of relatively good abrasion resistance, with better ductility than is obtainable from pearlitic or martensitic steels and white irons, could make such an austenitic steel widely acceptable for many types of service.

The influence of the austenite-retaining alloying elements, as discussed in section (1-d), may offer clues to the development of austenitic steels with superior abrasion resistance. Fully austenitic structures can be produced by using relatively "lean-alloy" combinations of manganese, nickel, chromium, molybdenum and possibly copper, along with high austenitizing temperatures and as much carbon as can be dissolved and kept in solution during heat treatment of the composition. The marked ball tests at Climax have indicated that certain of these lean-alloy combinations have substantially better abrasion resistance than the conventional 12 per cent manganese composition.

Quite probably all or most of these lean-alloy combinations will have inferior ductility to the 12 per cent manganese steel on a tensile test. However, these lean-alloy austenites would be competing with high-carbon pearlitic steels which normally have less than 2 per cent elongation on a tensile test, or with martensitic steels and white irons which show practically no ductility, so high ductility in the proposed lean-alloy austenite is apparently unnecessary.

TABLE 4 — COMPOSITION AND ABRASION FACTORS OF SEVERAL AUSTENITIC AND NEAR-AUSTENITIC STEELS

Item No.	Composition, — %					Austenitizing Temp, F	Hardness*		Relative Magnetism**	Abrasion Factor
	C	Mn	Cr	Mo	Ni		Rc1	Rc2		
1	1.5	0.8	6.0	1.0	—	2000	44	54	215	97
2	1.5	1.3	3.0	0.5	1.5	1900	30	55	85	103
3	1.5	1.3	3.0	0.5	1.5	2000	23	51	0	103
4	1.0	5.0	—	—	—	1900	18	49	0	124
5	1.2	11.6	—	—	—	1900	11	49	0	138
6	1.2	13.3	—	—	—	1900	—	49	0	141

*Hardness Rc1 represents the average hardness below the decarburized surface of the balls prior to the wear-in and wear test. Hardness Rc2 is the average Rc hardness on the worn surface of the balls after the wear test.

**Relative magnetism is the average pull in gr necessary to break contact between the worn surface of the balls and an Alnico magnet. For comparison the relative magnetism of a high-carbon martensitic steel with a low-retained austenite is 550 to 600.

There are two types of lean-alloy austenite which should be considered in any proposed study of austenitic steels with superior abrasion resistance. One type might be classed as "stable" because of the fact that it does not transform to a ferromagnetic product (probably a form of martensite), when it is work-hardened as "metastable" since it does transform to a ferromagnetic product when it is work-hardened. Normally a further addition of an austenite-stabilizing element or more complete solution of carbon will tend to change a "metastable" austenite into a "stable" austenite.

The tests at Climax have demonstrated that the lean-alloy austenites of the metastable type are not satisfactory for most grinding mill liners due to their tendency to spall in service. This is unfortunate, since some metastable austenites, obtained by the use of high chromium and carbon contents, have abrasion factors of less than 100 in those tests where they survive without spalling. Presumably some of these metastable austenites could be used successfully in light impact service, but their factor of safety would be low and their field of application would be limited.

The range of lean-alloy austenitic compositions which shows greatest promise lies between the metastable compositions and the highly stabilized 12 per cent manganese type of steel. Several compositions which were near or within this range have been studied in the marked-ball tests and are listed in Table 4, together with their abrasion factors. The conventional 12 per cent manganese type of steel is also listed for comparison.

Items 1 and 2 in Table 4 are definitely metastable, as is indicated by their hardness and their development of a ferromagnetic product on their worn surface. A slight amount of spalling occurred at the corners of the identifying notches of the test balls representing item 1 and a little more spalling occurred at the notches of item 2 during the wear tests in the Climax mills.

Item 3, which showed no transformation to ferromagnetic products, was satisfactory insofar as spalling is concerned. The identifying notches on the balls of this steel peened completely closed without any evidence of spalling. The steel apparently had reasonably good ductility along with a good abrasion factor. It presumably would meet the desired specification for a lean-alloy austenite with good wear resistance and

reasonable toughness. However, the only difference between item 3 and item 2 is a 100 degree F higher austenitizing temperature for item 3, so it is still on the verge of being metastable.

To provide a factor of safety, it would probably be desirable to increase the austenite retaining alloys to some extent. For example, both the nickel and manganese contents might be increased 0.5 per cent. According to the indications from Table 2, this would probably increase the abrasion factor of the steel to about 106 or 107 in the Climax mills. This would still be better than the limit of 110 mentioned earlier in this discussion.

Other possible modifications to the item 3 composition which might achieve the desired purpose, would be to add more chromium which should actually improve the abrasion resistance of the austenite. The possibility of using copper, as suggested by Lorig⁷, and by Carter and Rosenblatt⁸, in place of nickel or manganese should also be investigated. Effect of nitrogen in lean-alloy austenites may also be interesting.

Item 4 in Table 4 is a lean-alloy austenite achieved by the use of manganese alone. The manganese content, at the 1.0 per cent carbon level, is close to the minimum permissible for production of an austenite which is stable at room temperatures. It appeared to have good ductility and showed no evidence of metastability. In spite of a slightly lower carbon content, this 5 per cent manganese steel had better abrasion resistance than the 12 per cent manganese steel represented by item 5. However, the abrasion factor of 124 for item 4 still falls far short of the desired maximum of 110 for these lean-alloy austenites.

The results from items 4 and 5 suggest that manganese is such a potent austenite-retaining element and at the same time has such a powerful effect in reducing abrasion resistance that it would require a very delicate balance between manganese and carbon contents, (when used without other alloys), to produce a sufficiently tough austenite with the desired abrasion factor of 110 or less. Even if this proved to be possible, it would probably require such close control in regular production that it would be impractical commercially. The most fruitful field for exploration appears, therefore, to lie in the use of combinations of chromium, nickel, copper, and molybdenum. Moderate amounts of each of these alloying elements, in combination with a high carbon content and 1-2 per cent manganese, might be used to achieve the desired results.

To summarize this discussion on austenitic steels, we might state that the production of lean-alloy austenites with adequate toughness and better abrasion resistance than the 12 per cent manganese steels appears to be commercially possible. Much work remains to be done, however, to determine the best range of compositions and the wearing characteristics of these lean-alloy austenites. The rewards from this work could prove to be well worthwhile.

INFLUENCE OF HARDNESS OF THE ABRASIVE

In the previous sections of this paper, the abrasion factors, which are relative wear rates, are given for the steels and irons tested in the ball mills at Climax. It should not be inferred from this that these same abrasion factors will apply in other grinding mills. Experience from similar tests in other mills indicates that where a series of abrasion resistant alloys are tested in several mills grinding minerals of different hardness and size, the order of merit of each group in the series will generally remain the same; but the spread in abrasion factors between the best and the poorest may show a marked difference. This influence of abrasive hardness on abrasion factors has been studied by a number of investigators^{1,2,9,10,11}.

In general, the hard minerals such as quartz will produce less spread in abrasion factors than softer minerals such as feldspar and calcite. Also, there is evidence to indicate that there is less spread in abrasion factors when grinding a fine mineral than there is when the mineral is relatively coarse. In a two-stage grinding operation, which might involve a rod mill for coarse grinding followed by a ball mill for fine grinding, one should expect to find a greater spread in the abrasion factors of various ferrous alloys when tested in rod-mill liners than in the ball-mill liners.

A possible explanation of how the hardness of the abrasive influences the abrasion factors of ferrous grinding media is provided in Fig. 4. To obtain the data for this study, various groups of marked balls were run in a 3-ft diameter pilot plant ball mill for a number of 24-hr periods. Wear rates of the various groups of marked balls, when grinding three relatively pure minerals of different hardness under closely controlled conditions, were determined. For each test the abrasive mineral, which was about pea-size, was fed to the mill (and discharged from it) at a constant rate of 390 lb of mineral plus 130 lb of water per hour. The wear rates shown in Fig. 4 for a 0.80 per cent carbon steel at three hardness levels are typical of the results obtained.

It can be seen from Fig. 4 that in grinding quartz, which is approximately as hard as the martensitic steel and definitely harder than pearlitic steels, the wear rates of the three steels are relatively close to each other, with a spread of only 25 per cent between the hardest and softest steel. In grinding feldspar, which is definitely softer than the martensitic steel, but harder than the pearlitic steels, a spread of over 100 per cent exists between the two types. This is due to the marked drop in wear rate of the martensitic steel when it is grinding a mineral softer than itself. Under these circumstances, the martensitic balls be-

come highly polished while the pearlitic steels maintain a dull, scratched finish.

In grinding calcite, which is softer than all three steels, the wear rates of all three are very low, though there is still a spread of over 100 per cent in relative wear rates of the martensitic and pearlitic types.

A very similar trend has been observed in grinding commercial ores or minerals². In grinding high quartz ores, a small spread in relative wear rates has been obtained between the martensitic and pearlitic steels; while in grinding high feldspar ores, the martensitic steels (and martensitic white irons) show much greater superiority. Ores with a high iron oxide content produce results similar to high feldspar ores, due probably to the fact that hematite and magnetite have approximately the same mineralogical hardness as feldspar.

Cement clinker acts like calcite on the wear rate of steel grinding balls. The wear rates for all types of steel are very low, while at the same time a pearlitic steel will wear from two to four times as fast as a martensitic steel.

It may be interesting to note that calcite in these tests acted more like a lubricant than as an abrasive. The wear rates of the three groups of steel balls in water alone were about twice their wear rates in the calcite and water mixtures.

It is unfortunate that similar wear tests were not run with minerals whose hardness is between 6 and 3 on the Mohs' scale. This might move the points where the lines for the two pearlitic steels change their slope. For this reason the points between the feldspar and calcite wear rates have been connected with dotted lines.

SUMMARY AND CONCLUSION

- 1) A method of evaluating the abrasion resistance of materials for heavy-section steel castings, by running

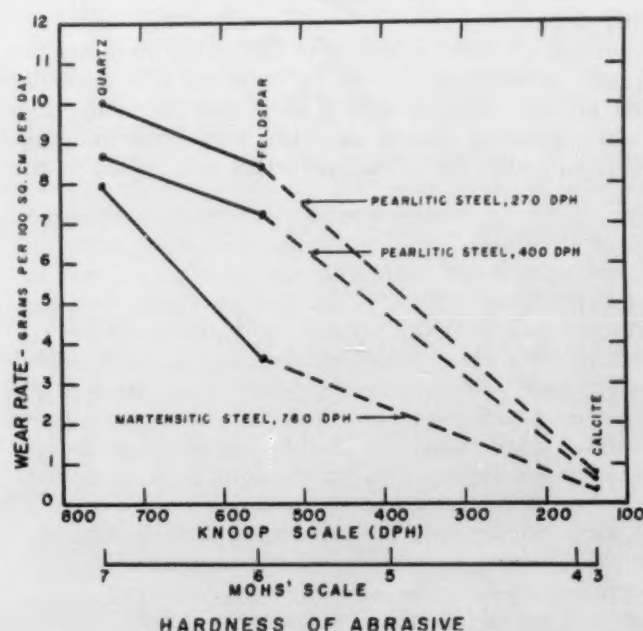


Fig. 4—Influence of hardness of the abrasive mineral on the wear rates of 0.80 per cent carbon steel grinding balls at three hardness values.

these materials as large-sized marked balls in a ball mill, is described. By this means it is possible to evaluate the relative merits of grinding mill liner materials within a short time. The results from this short-time test correlate well with the results from actual sets of liners having similar composition and structure.

2) Martensitic structures tend to improve in abrasion resistance as their carbon content is increased and as their austenitizing temperature is increased. Tempering up to 400-500 F has little or no effect on their abrasion resistance but tempering at higher temperatures rapidly reduces this abrasion resistance.

3) Elements which tend to increase the retained austenite in a fully hardened steel have an effect on its abrasion resistance. Chromium and carbon, when in solution, tend to improve abrasion resistance while manganese and nickel tend to reduce abrasion resistance.

4) The high-carbon martensitic steels compare favorably to the martensitic white irons in abrasion resistance when tested in Climax ball mills.

5) Pearlitic structures tend to improve in abrasion resistance as their carbon content is increased up to about 1.0 per cent and as their hardness is increased.

6) Pearlitic Cr-Mo steels show little if any loss in abrasion resistance when tempered up to 1000 F. When tempered at 1100 F or higher, their abrasion resistance is lowered to some extent.

7) As-cast pearlitic Cr-Mo steels are usable and satisfactory as liners under some conditions.

8) Pearlitic Cr-Mo steels with a hardness of 38-40 Rc are more abrasion resistant than bainitic structures having the same composition.

9) Abrasion resistance and other characteristics of several austenitic steel compositions are presented and discussed. Good possibilities appear to exist for the development of "lean alloy" austenites with adequate toughness and better abrasion resistance than conventional 12 per cent manganese steel.

10) When a series of ferrous alloys are tested in grinding abrasive minerals of different hardness, the range in abrasion factors so obtained will normally be greater when grinding the softer minerals than when grinding quartz or other very hard minerals. Consequently, the abrasion factors established in the

Climax ball mills may show a greater or less spread when tests on these same materials are run in other mills grinding minerals of different hardness.

ACKNOWLEDGMENT

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A LITTLE KNOWLEDGE OF PLASTICS

By

Robert LeMaster*

The old adage of a little knowledge being harmful could never be truer than when speaking of plastics. In the past and at present, this little knowledge of plastics has been a definite factor in their lack of acceptance by the foundry industry.

Plastics definitely have a place in the foundry. The exact degree of acceptance and usage may not be established for years to come. At the present time, few people realize what lies ahead in new materials and techniques.

The growth of plastic pattern equipment may be compared with shell molding and the CO₂ process. When each was first introduced, they were misapplied and oversold. Each of these processes has limitations to its application and should not be thought of as a cure-all. When foundries began experiments with these processes little was known about testing procedures for them, and many unfavorable reports resulted. In the face of these discouraging reports, only the pioneering foundrymen continued experiments until the necessary knowledge of practical workability was established.

EARLY DIFFICULTIES

In the case of plastics, the original unfavorable reports were due to the premature introduction of phenolic plastics. This family of plastics was oversold, misrepresented, and misused because little was known of them. Phenolic pattern equipment made today is much more acceptable and usable than the type made several years ago. This is because of improvements in materials, and a definite understanding as to what can be expected of them.

Possibly, the best way to approach a new pattern material is to evaluate through past experience what qualities it should have. Desirable qualities are high dimensional stability, high strength and versatility. Epoxy resins now being used, because of low shrinkage, have high dimensional stability. Because they have excellent adhesion and are nonreactive with

other materials, high strength may be obtained through the use of various fillers and reinforcing materials. These same properties plus room temperature cure establish epoxies as a very versatile material.

Why then the apparent rejection of such a versatile material by many foundries? The reasons are numerous, but in all cases, reflect a need for more knowledge of materials and methods.

The first thought that comes to most people's minds when plastics are mentioned are plastic toys and their short life under a child's abuse. These same people fail to realize the vast range of properties that exist in various families of plastics. What better examples of plastics properly applied than formica counters, plastic seat covers, nylon hose, or fiberglass boats?

The people who were taken in by the phenolic pattern era won't soon forget how a great deal of money went into patterns which soon cracked or lost their accuracy through shrinkage.

Their experience formed a resentment against plastics, not phenolics. Before these people bank on any plastic as a pattern material, they will have to be familiar with its properties and have a more complete knowledge of it.

The versatility and ease of workability has been a definite disadvantage to the acceptance of epoxies. Numerous orders have been received by plastic formulators from shops desiring 2 or 3 quarts of resins or samples for experimenting. After minor experimenting with their samples, they attempt to establish themselves as experts. Not knowing anything about a resin other than it's workability, they begin construction. After completion, their pattern equipment may appear very acceptable, but may fail under use because of insufficient mixing, voids in the laminations, air bubbles in pouring applications, or improper construction.

Lately, there is a trend among formulators and plastic sales people to recommend that plastic work be done by established shops which recognize the limitations of epoxies, are able to recommend proper applications, and also to reject questionable applications. This trend is a result of the plastic formulator's attempt to flood any interested shop with sample materials to acquaint them with their toughness and versati-

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lity. The results of this flooding have been two-fold. In many cases, its results were as intended, but in numerous other cases it ruined master patterns, it foamed, or it failed. These failures are mostly attributed to the user's substitution or addition to the plastic formulator's directions.

The literature published by some epoxy formulators has led purchasers of plastic equipment to believe that such equipment could be produced for fantastically low figures. Such instances report how a core box is produced in 2 or 3 hours, and possibly a pattern in a similar amount of time. These examples may be true, but since so few patterns and core boxes fall into their size and shape, their representation is misleading. Pictures and cost comparisons of more complex equipment, plus construction details would give purchasers a more complete story.

SPECIFICATION PROBLEMS

This item—"construction details" has caused much concern among pattern shops. When requesting quotations on metal equipment most purchasing agents have learned to state such specifications as: cast to size, machined, sand cast, or pressure cast, aluminum or cast iron. On quotations for wood equipment—pine or mahogany?

Much effort has been put into trying to establish pattern construction categories such as class "A", "B", "C", or "D". These pattern standards are just now being used for established materials that have been used for centuries. Let's not wait centuries to acquaint purchasers of plastic pattern equipment with our various construction techniques and standards.

Now is the time for plastic formulators and plastic fabricators to combine their standard material specifications with complete information concerning all construction techniques with advantages and disadvantages of each. Perhaps, case histories of several sets of pattern equipment built by various construction methods to produce a similar casting should be included to help foundries to determine which may best suit their needs. All of this should then be presented as a booklet which would be available to any interested party. This booklet would then serve as a guide for the purchase of any plastic pattern equipment.

With the idea that plastic materials will continually improve and their use will take an ever increasing percentage of wood and metal work, we should begin to acquaint our apprentices with them. Their experience with plastics now would only serve as a stepping-stone to a future trade of a plastic patternmaker. We have found that these apprentices learn to apply this newly found knowledge to great advantage in wood and metal patternmaking. They have learned

to save considerable time when working with loose pieces, interchangeable pieces, engineering changes, patching, repairing, and developing complex shapes. Larger companies that now have extensive apprentice training programs could well prepare themselves for the future by integrating plastic work with wood and metal training.

USES OTHER THAN PATTERNS

Much has been said of various fabricating techniques to acquaint shops in the use of plastic for pattern and core box use. This concentration of knowledge for these uses has left a definite void in the field of potential foundry applications. Many types of fixtures now used in our foundries are perfect applications for plastics but are neglected because so little has been said of their proper construction techniques.

These fixtures include casting inspection fixtures, core setting fixtures, core pasting fixtures, water test fixtures, overall gauges, and core handling fixtures. The fabricating techniques used for this type of work involves plastic tubing with wrapped joints and shot faces, steel wear pads and flush check pins, location bushings and plates. The plastic formulators have been very lax in providing shops with adequate information, examples, and technical know-how for them to construct anything but experimental fixtures. Future education for pattern shops regarding this fixture type work could result in a great deal of fabrication work including plastics as their primary feature. The know-how given the pattern shops would soon transplant itself in the form of knowledge among foundry personnel as to what the entire potential of plastics in the foundry represents.

The area of limitations for plastic construction is misleading considering the vast number of uses which have proved satisfactory. These include vacuum forms, foaming molds, compression molds, and injection molds. Also dies; holding, checking, and spotting fixtures; duplicator models; inspection fixtures; boring and drilling fixtures; and of course, the entire pattern field. The do's and don'ts of plastic construction rely on past experience and plastic formulator's recommendations.

The future of plastics in the foundry industry hinges directly on the plastic formulators' ability to perfect new and better products. It is also their responsibility to see that any new products are introduced by trained personnel with trade knowledge and experience. They must treat any new product with a degree of pessimism to restrict misapplications, and a degree of optimism to instill progressive thinking. These formulators rely on our criticism to better improve their product. Cooperation and criticism can lead to a great future for plastics in the foundry industry.

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WRITTEN DISCUSSION IS SOLICITED

PROGRESS IN VACUUM DIE CASTING

By

David Morgenstern*

This year has seen the vacuum die casting process being rapidly accepted as a new and valuable tool for the production of better, sounder die castings. We have seen the process emerge from the prototype stage to where it is now being widely accepted throughout the industry, and has had application in many of the more progressive plants producing high quality, zinc-base die castings. Many reports are coming in regarding operations on both new and converted machines which demonstrate the many benefits to be obtained by using vacuum on a die casting process.

The die casting industry has long been looking for an answer to the many problems besetting the die caster who is being called upon to produce better castings than ever before. The vastly increased use of die castings has made the customer and user of these castings much more conscious as to the quality of finish, dimensional tolerance and porosity. This has pushed the die caster to his limit in what he can do with the equipment available today.

The use of vacuum in the die casting process has been a major break-through in the ability of the die caster to produce better castings at a lower cost. The very nature of the die casting process has within itself the seeds for trouble, due to the fact that when molten metal is injected into dies at high pressures and speed, the possibility of removing entrapped air and gas is limited, as illustrated in the accompanying drawings. The sudden injection of molten metal upon relatively cold dies causes any escape vents for air to be sealed by the first flush of metal spraying into the die.

This entrapped air in a die has been the root of many troubles of die casting. Among these have been the resultant poor finish due to the layer of air which is trapped between the molten metal and the die surface, causing surface irregularities. The other troubles due to air have been porosity in the casting, irregular cooling of the casting so as to show sink marks where heavy sections join light walls of the casting, and the need for higher and higher injection

pressures to try to compress the trapped air into small particles which will be tolerable.

HOT CHAMBER PROCESS

For years die casters have attempted to use vacuum as an aid in the die casting technique, but the many schemes which have been attempted have all failed because they were not practical in application to the die casting foundry. The successful system presents the die caster an effective method of evacuating the die cavities, is simple and rugged, does not hinder or slow down the operation of the machine. The process, as applied to the hot chamber zinc machine, consists essentially of two hoods, one mounted on the fixed platen of the machine, and one mounted on the movable platen of the machine, meeting at the die parting line through a compressible seal.

The hoods are easily opened and sections removed for convenient access to the die platens for die setting and maintenance. A vacuum pump and large vacuum accumulator are connected to the hood by means of a large vacuum pipe with the necessary valving. Means have been provided, Fig. 1, to cover the metal

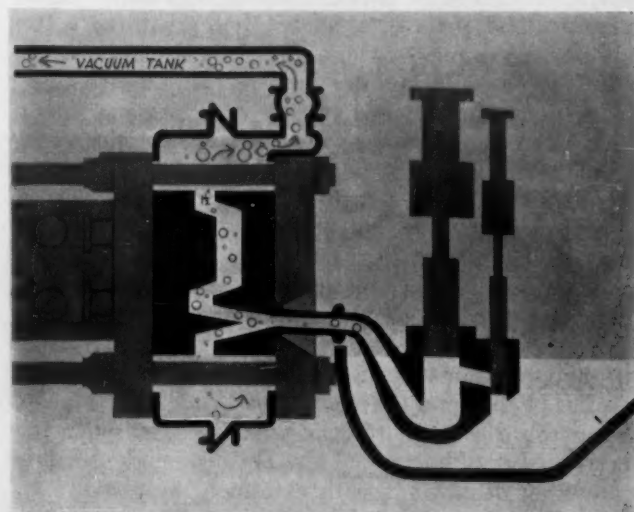


Fig. 1—Metal filling port is closed to prevent metal from being drawn into die.

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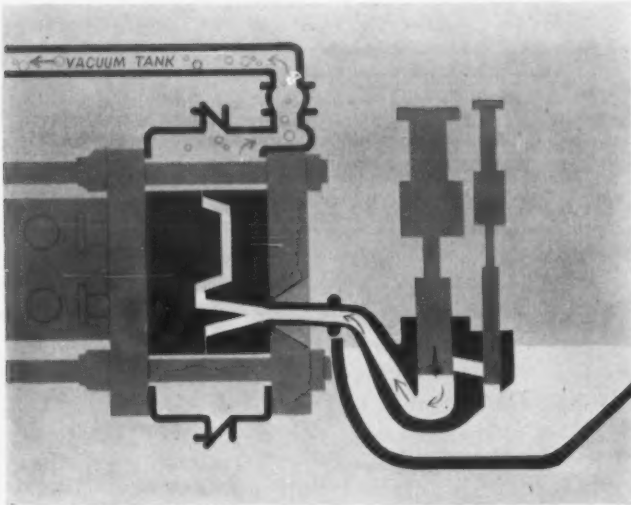


Fig. 2—Vacuum valve connecting accumulator to hood is opened and hood is evacuated.

filling port on the injection cylinder (goose neck) to prevent metal being drawn up into the die when vacuum is applied.

Through the proper electrical sequencing, the machine is momentarily paused at the point where the two hood faces contact each other and the die faces are still apart. The large vacuum valve connecting the hood to the accumulator is opened and the hood evacuated in a fraction of a second, Fig. 2. As this evacuation is completed, the machine closes, compressing the hood face seal, and the metal is injected into the die, Fig. 3. After metal is injected into the die, atmosphere is again introduced into the hood, the dies opened and the part removed. Because of the large valves and accumulator used, the evacuation cycle is only a split second of the entire machine cycle.

The many metallurgical benefits which accrue from the use of vacuum have been well covered in a previous article, and need not be discussed at the present time.

BENEFITS OF VACUUM CASTING

The first and foremost practical benefit has been the drastic reduction of porosity in castings made under vacuum. The surface finish of these castings is far superior, reducing the amount of finishing work required to prepare them for both painting and plating. Because of the reduced porosity and air entrapment, it has been found that castings produced under vacuum will stand much higher heat ranges for subsequent operations such as painting, permitting the use of higher temperatures and thereby speeding up the painting cycle. In at least two cases, vacuum die casters have put oversize platens on their machines and are running much larger castings than the machines were originally designed for, due to the reduction of injection pressures needed to make sound castings.

It has been found that metal flows much more freely within the dies with the air evacuated, without the back pressure of entrapped air. This has made possible production of castings with extremely light wall sections which were heretofore totally impossible to fill. Reductions in weight have been possible because

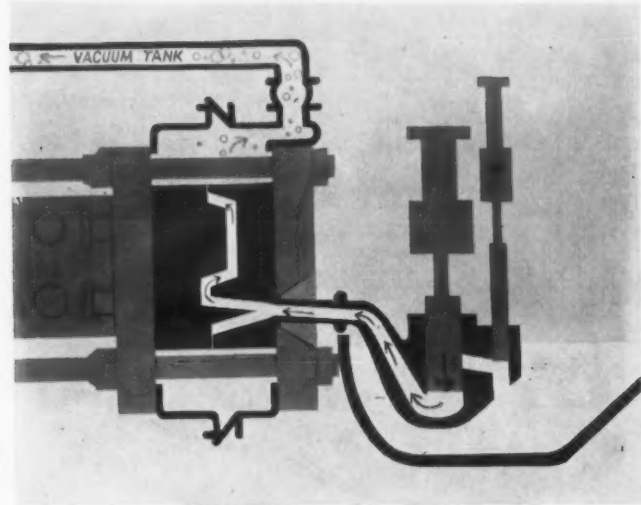


Fig. 3—Machine closes and metal is injected into die.

of the process. In one case, a prominent jobbing manufacturer of die castings has been able to produce a television frame mask as a zinc die casting in competition with aluminum by keeping the wall section thin enough to equal aluminum in weight, thereby making substantial savings in the part.

It has been found possible to produce castings of a large surface area with many projecting bosses. Without vacuum there was a high percentage of rejects due to sink marks where the boss projected from the flat surface. It has been found easier to keep dimensional limits because of the lowered injection pressure when using vacuum. The uniform density of castings produced under vacuum made it possible for one manufacturer to produce ordnance parts which formerly were produced from bar stock to meet the necessary uniform weight requirements.

Several users of the vacuum system have done an outstanding job of getting customers to take advantage of castings produced under vacuum, and to specify vacuum cast parts for their requirements.

CASE HISTORIES

An interesting case history has been the production of a large auto tail light frame. This 12-1/2-lb casting being cast on a 750-ton machine with a reject rate of 30 per cent due to bad surface conditions creating finishing problems. The die was transferred to a 400-ton machine and run under vacuum. It has been running on production with surface condition rejects cut from 30 to 5 per cent.

One large manufacturer of hardware installed a machine and trials have been so encouraging that an additional order has been placed for a much larger machine. The ability to paint castings at a higher temperature permits a much greater volume of work with the present painting setup. Another benefit was the reduction in cost to prepare castings for plating.

A die caster in Illinois was casting an automobile radio bezel. He was able to reduce the weight of the bezel by 2-1/2 oz, a 12-1/2 per cent decrease. The number of good castings from the machine increased from 90 to 130 per hour. This caster is also producing a metal coin bank, oblong in shape and approximate-

ly 3 in. deep, with a thin wall section. This part was never produced satisfactorily, due to the poor finish caused by entrapped air. Under vacuum, the parts had a satisfactory finish, requiring no polishing. The customer was satisfied to the point of releasing another 25,000 parts, rather than taking the die away as originally anticipated.

A producer in Michigan has produced a clock bezel which, for all practical purposes, was impossible to produce on standard equipment, and still meet the cost requirements. The use of vacuum equipment has permitted them to produce this part successfully.

Another firm used the equipment to produce a part with a heavy section which had caused the customer to scrap up to 50 per cent of the parts because of porosity. Vacuum die castings have reduced rejects from this cause to an acceptable 5 per cent.

A large producer of automobile parts in Ohio, producing a tail lamp housing, was able to reduce finishing costs by \$24.00 per thousand pieces. This saving was made by dropping the polishing operations needed before buffing when the parts were cast without vacuum.

These are some representative cases where an established die caster, using all his "know how" and good die casting practice, has used this additional tool to produce a better and more economical casting. Vacuum casting is not a cure-all. It does not take the place of good die casting practice. It will, however, in the hands of a competent die caster, produce superior castings at lower costs. The use of vacuum in the zinc die casting field has unlimited horizons. Many product designers are now recognizing the possibilities of producing much lighter, thinner wall section castings of more intricate design than heretofore practically possible.

It is now possible for the designer of die castings to produce die castings which will compete on a cost basis with stampings and stamping assemblies. By the use of vacuum, reject rates are drastically cut, both at the machine and subsequent operations. It also cuts down the amount of time necessary for breaking in dies and for the development of runners, overflows and vents to try to get rid of air through conventional practices. The designer can now concentrate on the actual die design to produce the best system in the die for proper heat balance without worrying about the effects of entrapped air. Because tensile strength and elongation factors are improved in the casting, more subsequent operations can be performed on the casting. Such processes as bending, riveting, swedging can now be performed much more satisfactorily. Machining rejects due to porosity can be drastically cut.

COLD CHAMBER PROCESS

The past year has also seen an intensive development program on the vacuum process as it applies to the cold chamber, aluminum die casting machine. The cold chamber machine, being a later development, is just now coming out of the testing stage. From the several machines now in test, enough information has been gathered to show the great potential of the process as it applies to the cold chamber machine. In addition to the many benefits as experienced in the hot chamber, zinc machine, there is the obvious

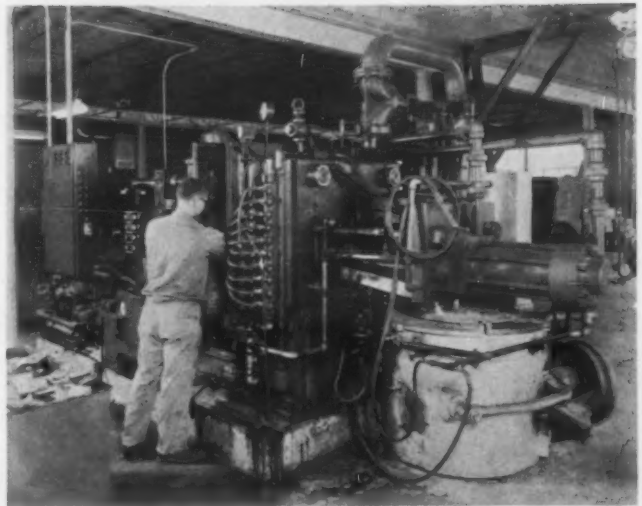


Fig. 4—Cold chamber machine expands principles of zinc machine to include evacuation of air from cold chamber.

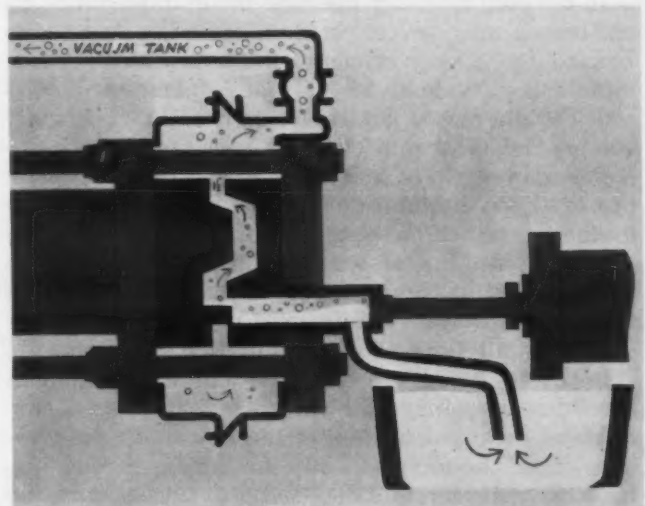


Fig. 5—Cold chamber machine incorporates automatic feeding of metal from furnace.

benefit of automatic feeding of metal from the furnace directly into the machine. One of the high cost factors about aluminum die casting has been the necessity or the hand ladling of metal from the furnace into the cold chamber. This is an arduous and weary task for the operator, besides slowing down the entire cycle of operation.

In the cold chamber machine, Fig. 4, the basic principles as evolved by the zinc machine are further expanded in that the vacuum as it is applied in the hood evacuates the air from the cold chamber which is in direct communication to the die. By the simple expedient of connecting a feed tube from the bottom of the cold chamber directly to the furnace, metal is then automatically drawn up by means of vacuum into the cold chamber while the dies are spaced apart and the hood closed, Fig. 5. By means of a sequence timer and orifice in the metal feed tube, the amount of metal is controlled accurately so that after a predetermined amount is pulled up into the cold chamber, the machine closes up and fires, Fig. 6. The cycle then approaches that of a hot chamber machine in speed.

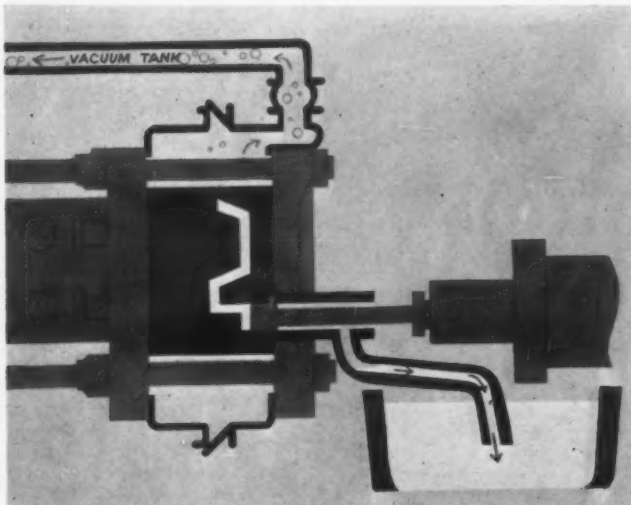


Fig. 6—After a predetermined amount of metal is pulled into chamber, machine closes.

In the cold chamber machine the entrapment of air has been a more severe problem, since the cold chamber itself is a very efficient air compressor and contains a large volume of air that is pumped directly into the die cavity, and must of necessity be highly compressed. The cold chamber vacuum machine operates at cycle times equivalent to that of a hot chamber machine. Because the metal feed tube opens up in the center of the supply furnace, clean alloy is sucked up into the die without the sludges and oxides which would be transferred by hand ladling. Because the alloy, in transit from furnace to die, is kept under vacuum at all times, there is no oxidizing or air pick-up.

It is now possible to die cast alloys of aluminum heretofore unmanageable in the ladling process. Because of the rapid transfer of metal without the presence of air, the increased injection pressures, and better ability to fill the die cavities, silicon normally used for purposes of fluidity can now be dropped out of the alloy, permitting the use of high strength, high ductility alloys which could not be cast successfully before.

The practical use of low silicon alloys opens up the field of anodizing finishes. Enough results have been obtained to date to show the practicability of the

process as it applies to anodizing. In the anodizing process, any oxide inclusions or surface porosity become immediately visible because of the etching nature of the anodizing process. The freedom of vacuum-cast aluminum castings from surface porosity and oxide inclusions has made anodizing possible. Results of anodizing low silicon alloys in color have been highly encouraging, and for many applications anodizing is now a commercial reality.

As a result of a development program carried out between Reynolds Metals Co., Nelmore Mfg. Corp., and Reed-Prentice Corp., two new alloys have been developed for the vacuum die casting field which show great promise.

Both these alloys were developed with anodizing in mind. However, their mechanical properties and anti-corrosion characteristics have been outstanding. The L-214 is a 2.5–4 per cent magnesium alloy, with less than 1 per cent silicon. This is a high strength alloy with about 7 per cent ductility. A most interesting alloy is the MD-24, which is a 4 per cent zinc alloy with less than 1 per cent silicon. This alloy is highly ductile, having 17 per cent elongation. It is also corrosion resistant, takes to anodizing finish nicely and shows great promise for both finished parts and mechanical parts where high ductility and ability to bend, form and twist the casting is necessary. Both of these alloys are very difficult to handle by hand ladling. Some of the results obtained have shown the ability to cast very thin wall sections of aluminum. Castings have been made using zinc dies in which the wall sections were running about 50 per cent thinner than a normal aluminum die. These castings would normally be prohibitive in their difficulty to run on a leading machine. They are run without any problem whatever on the vacuum machine.

The cold chamber machine, equipped for the vacuum process, presents for the first time a truly universal machine in its ability to run aluminum, zinc and magnesium on the same equipment. Long production runs on zinc parts have been made on a prototype machine, showing comparable speeds on medium and heavy section zinc parts to a hot chamber machine. The hot chamber machine still is needed to produce thin wall zinc sections requiring hardware finish.

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WRITTEN DISCUSSION IS SOLICITED

MAGNESIUM CONTENT AND GRAPHITE FORMS IN CAST IRON**

By

James F. Ellis* and C. K. Donoho*

ABSTRACT

The effect of increasing magnesium content in three different base irons on tensile properties and graphite structures are determined. The transition structures in changing from flake graphite to spherulitic graphite are shown and discussed. Also the effect of excessive magnesium content on graphite form is shown. An extension of the standard system of graphite classification is suggested.

EXPERIMENTAL PROCEDURE

Three distinct types of base iron compositions were separately melted in a 500-lb capacity basic lined high frequency induction furnace. In each case, the metal was heated to 2800 F and covered with a layer of calcium carbide to lower the base sulfur content to around the 0.01 per cent sulfur level. The metal was then cooled to and maintained at 2600 F throughout eleven successive taps into a 100-lb capacity shank ladle. Increasing additions of magnesium-ferro-silicon alloy*** were added to the stream pouring into the hand ladles. Additions of 75 per cent ferro-silicon were also made at the tap, so adjusted in amount to maintain the final silicon content reasonably constant with varying additions of the magnesium-silicon alloy. Standard Steel Founder's Society of America keel blocks were cast from each tap.

Tensile and hardness values were obtained on standard 0.505 in. diameter tensile bars machined from coupons in both the as-cast condition and after a ferritizing anneal.

MECHANICAL TEST RESULTS

Tables 1, 2, and 3 show the base compositions and the average mechanical properties obtained on the three irons studied. The first heat was a typical hyper-eutectic composition, the second a typical hypo-eutec-

tic composition, and the third hypo-eutectic with an extremely low manganese content. The hyper-eutectic melt (Table 1) had about 15 per cent of pearlite in the as-cast condition, and the two hypo-eutectic melts had about 30 per cent pearlite as-cast. The annealed bars in each case were substantially pearlite-free.

In order to plot the data together, the values—tensile strength, yield strength and elongation—were recalculated for each series as percentage values of the highest value. These charts are shown in Fig. 1, 2 and 3. Tensile and yield strengths for these three irons

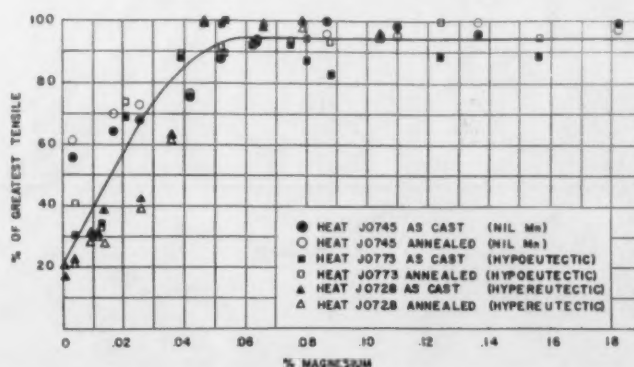


Fig. 1 - Influence of magnesium content on tensile strength of ductile iron (as-cast and annealed).

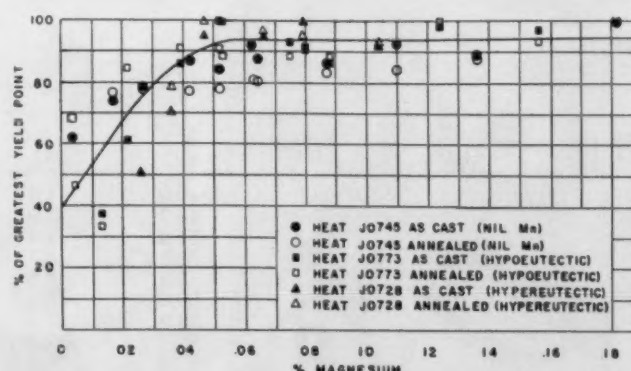


Fig. 2 - Influence of magnesium content on yield strength of ductile iron (as-cast and annealed).

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**A contribution of the Microstructure of Cast Iron Committee (5K) of the Gray Iron Division.

***8.0% Mg, 47.0% Si, 0.8% Al, balance iron.

TABLE 1 - INFLUENCE OF MAGNESIUM CONTENT ON PHYSICAL PROPERTIES OF HYPEREUTECTIC DUCTILE IRON (AS-CAST AND ANNEALED).

Heat Number J0728		Average Base Composition							
Hypereutectic		Si 2.85	S 0.012			Mn 0.23	P 0.036		T.C. 3.66
		Tensile Properties							
		As-cast				Annealed			
Sample No.	% Mg	T.S. x10 ⁻³	Y.S. x10 ⁻³	% El.	Bhn	T.S. x10 ⁻³	Y.S. x10 ⁻³	% El.	Bhn
1	0.001	12.3	None	0.8	97	14.2	None	1.3	Soft
2	0.0038	15.7	None	1.3	97	14.8	None	1.2	Soft
3	0.0094	22.6	None	0.7	116	19.1	None	0.6	109
4	0.0140	27.9	None	2.0	130	19.1	None	1.6	103
5	0.0114	22.4	None	1.8	121	20.4	None	0.8	109
6	0.026	30.0	27.2	2.0	134	26.7	None	1.7	119
7	0.036	45.1	37.6	3.4	149	41.6	39.1	2.5	140
8	0.047	71.2	50.1	23.7	163	68.0	49.8	26.8	158
9	0.066	70.5	50.7	22.3	156	67.6	48.2	25.8	156
10	0.079	71.6	53.3	23.1	161	65.9	47.3	23.8	153
11	0.104	68.6	49.3	20.6	158	63.9	46.2	25.7	149

TABLE 2 - INFLUENCE OF MAGNESIUM CONTENT ON PHYSICAL PROPERTIES OF HYPOEUTECTIC DUCTILE IRON (AS-CAST AND ANNEALED).

Heat Number J0773		Average Base Composition							
Hypoeutectic		Si	S			Mn	P		T.C.
		3.38	0.008			0.18	0.033		3.14
		Tensile Properties							
		As-cast				Annealed			
Sample No.	% Mg	T.S. x10 ⁻³	Y.S. x10 ⁻³	% El.	Bhn	T.S. x10 ⁻³	Y.S. x10 ⁻³	% El.	Bhn
1	0.004	28.1	None	1.0	131	32.9	29.3	1.7	147
2	0.013	30.9	25.4	1.1	170	26.5	21.2	1.8	124
3	0.022	64.1	41.6	2.7	170	59.8	53.2	4.3	167
4	0.039	81.6	58.5	9.6	183	71.3	57.1	14.0	170
5	0.052	92.0	68.1	13.3	195	73.7	56.9	21.4	170
6	0.053	92.9	67.9	14.1	197	72.0	55.3	22.5	169
7	0.075	85.1	63.6	14.7	181	74.3	55.8	25.1	174
8	0.080	81.6	62.6	19.1	177	75.7	57.5	25.4	166
9	0.088	76.7	58.7	20.6	177	74.2	55.6	24.9	169
10	0.124	82.2	66.7	19.4	181	80.6	62.9	20.7	177
11	0.156	82.0	66.4	8.8	185	76.4	58.5	17.8	177

TABLE 3 - INFLUENCE OF MAGNESIUM CONTENT ON PHYSICAL PROPERTIES OF HYPOEUTECTIC - NIL-MAN-GANESE DUCTILE IRON (AS-CAST AND ANNEALED)

Heat Number J0745 NIL Mn		Average Base Composition							
		Si	S			Mn	P		T.C.
		3.04	0.006			0.018	0.028		3.02
		Tensile Properties							
		As-cast				Annealed			
Sample No.	% Mg	T.S. x10 ⁻³	Y.S. x10 ⁻³	% El.	Bhn	T.S. x10 ⁻³	Y.S. x10 ⁻³	% El.	Bhn
1	0.004	46.3	40.9	1.4	149	45.3	42.0	1.9	155
2	0.017	53.0	48.2	2.0	159	51.6	46.9	3.1	152
3	0.027	57.1	51.4	1.4	172	54.5	47.8	3.0	154
4	0.042	64.4	56.8	2.3	176	56.4	47.0	5.6	154
5	0.052	74.1	55.3	8.1	163	65.8	47.5	16.2	157
6	0.063	77.8	60.0	5.3	190	68.0	49.6	16.0	154
7	0.064	78.6	56.9	22.4	172	69.3	49.1	26.3	161
8	0.087	84.0	56.7	19.3	183	70.6	51.0	26.5	161
9	0.110	82.4	60.4	19.0	175	70.5	51.8	27.0	157
10	0.136	80.5	58.5	21.6	176	73.7	54.1	25.4	163
11	0.182	83.7	65.4	5.9	192	72.2	61.6	6.5	177

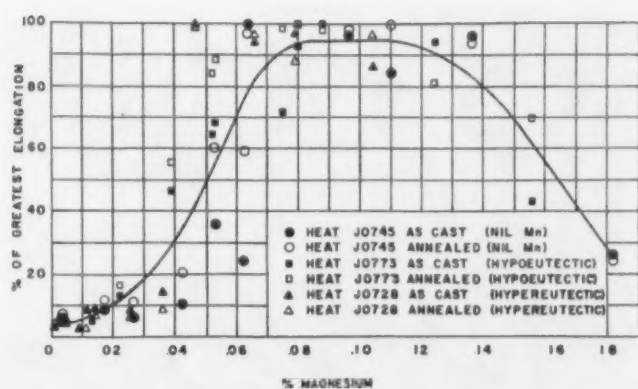
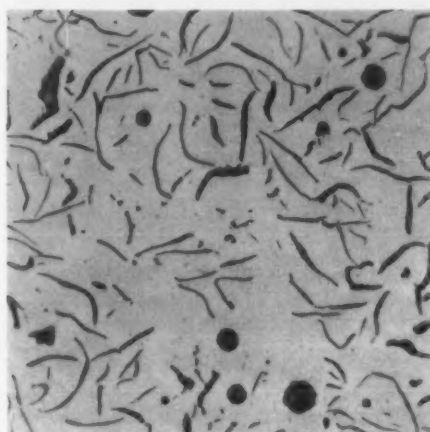
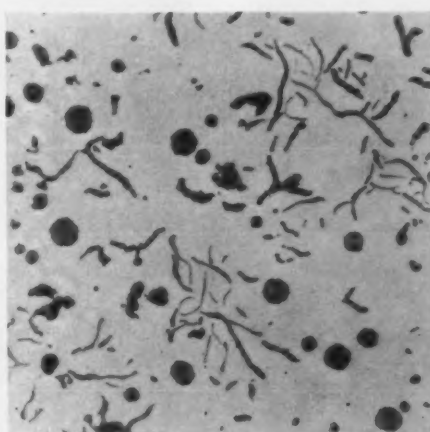


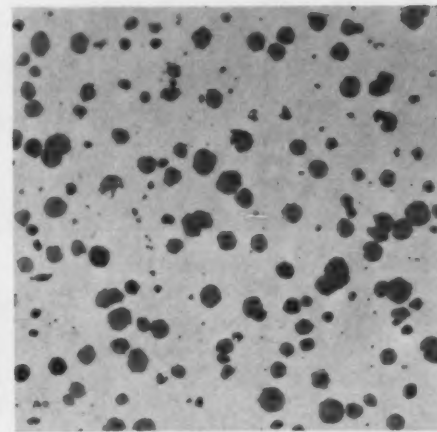
Fig. 3—Influence of magnesium content on elongation of ductile iron (as-cast and annealed).



(a)

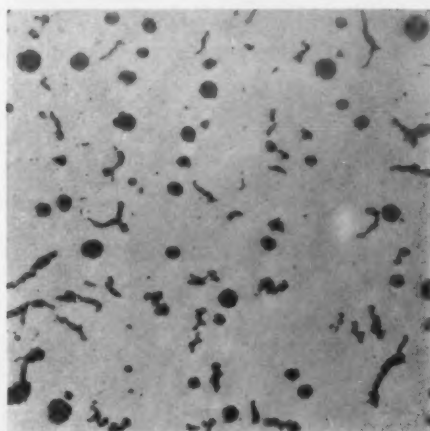


(b)

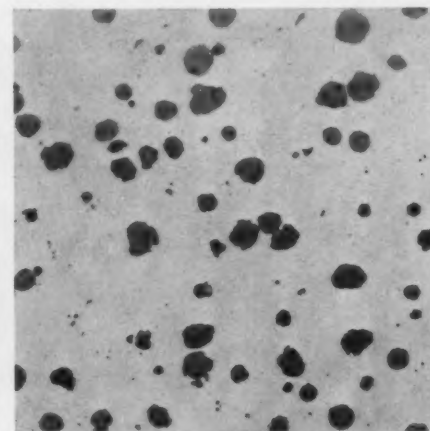


(c)

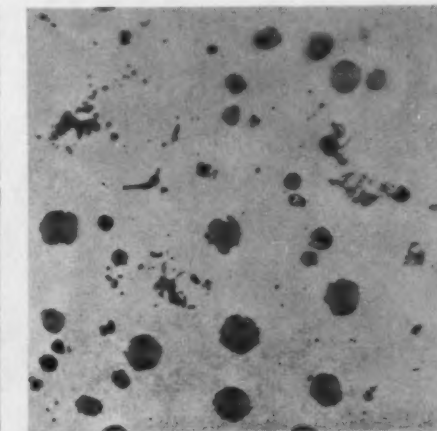
Fig. 4—Effect of magnesium on graphite structure of No. J0728 (hypereutectic). (a) 0.026% Mg. (b) 0.036% Mg. (c) 0.079% Mg. unetched. $\times 100$.



(a)



(b)



(c)

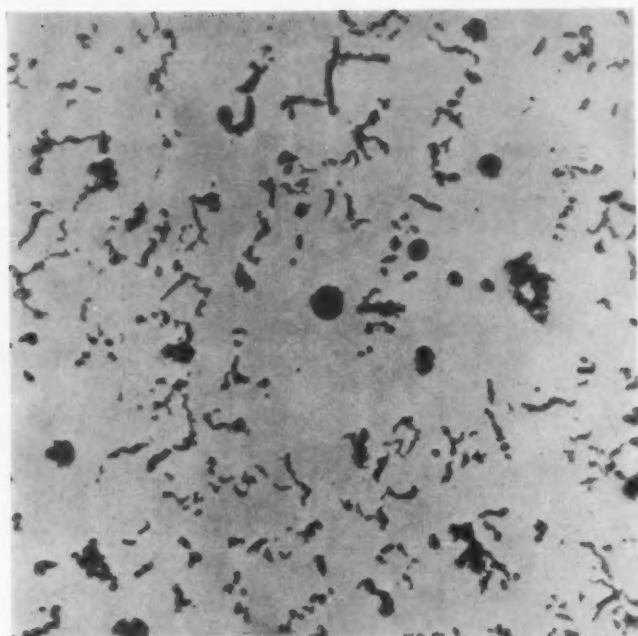
Fig. 5—Effects of magnesium on graphite structure of No. J0773 (hypoeutectic). (a) 0.027% Mg. (b) 0.080% Mg. (c) 0.156% Mg. (d) "Quasiflake" from sample "a". (e) "Spikey" graphite from sample "c". (a), (b) and (c) unetched. $\times 100$; (d) and (e) unetched. $\times 500$.



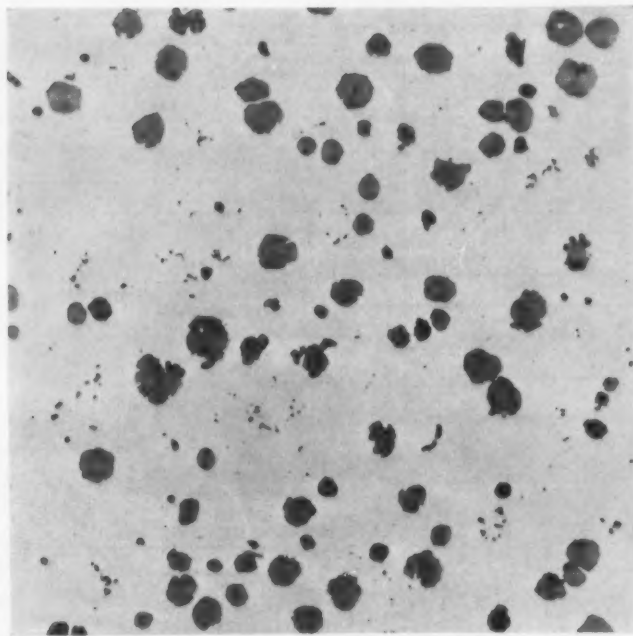
(d)



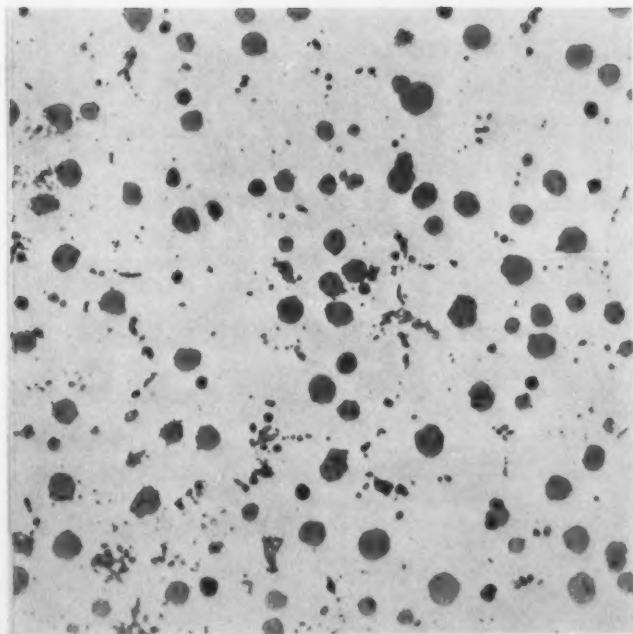
(e)



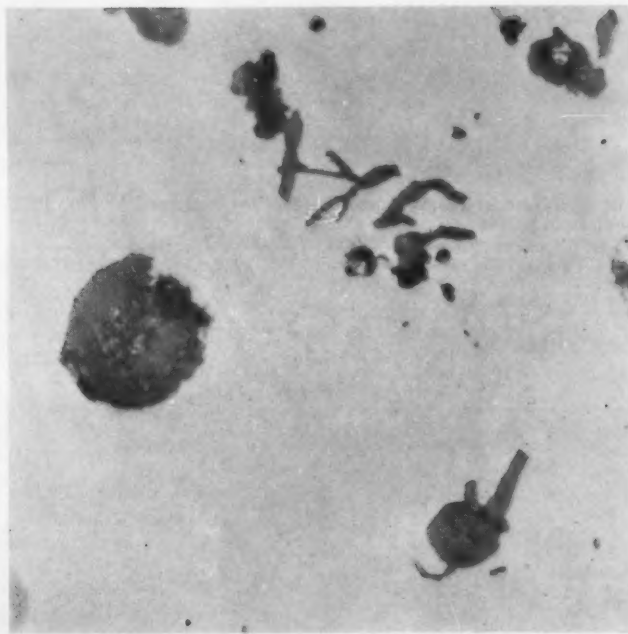
(a)



(b)



(c)



(d)

Fig. 6—Effects of magnesium on graphite structure of No. J0745 (nil Mn). (a) 0.017% Mg. (b) 0.063% Mg. (c) 0.182% Mg. (d) "Spikey" graphite from sample "c". (a), (b) and (c) unetched. $\times 100$; (d) unetched. $\times 500$.

reach a maximum at about 0.05 per cent magnesium* which is maintained with increasing magnesium content, at least to the highest levels of magnesium obtained in these series. The elongation values, however, after increasing similarly to a maximum show a definite down-turn with magnesium content increased above about 0.14 per cent. This is discussed later.

*The authors recognize that with different metal conditions, and especially by sampling some time after the magnesium addition, substantially lower magnesium contents are found to give maximum properties.

TYPICAL GRAPHITE STRUCTURES

Figure 4, (a), (b) and (c) shows the effect of increasing magnesium content on the graphite form of a hyper-eutectic melt. The increasing magnesium progressively decreases the proportion of flake graphite and increases the proportion of spherulites. It is interesting that in the hyper-eutectic melt there are essentially only two types of graphite—flakes and spherulites, and little definite "quasi-flake" or other intermediate forms. It is unfortunate that in this melt there was no sample with very high, or excessive, magnesium content.

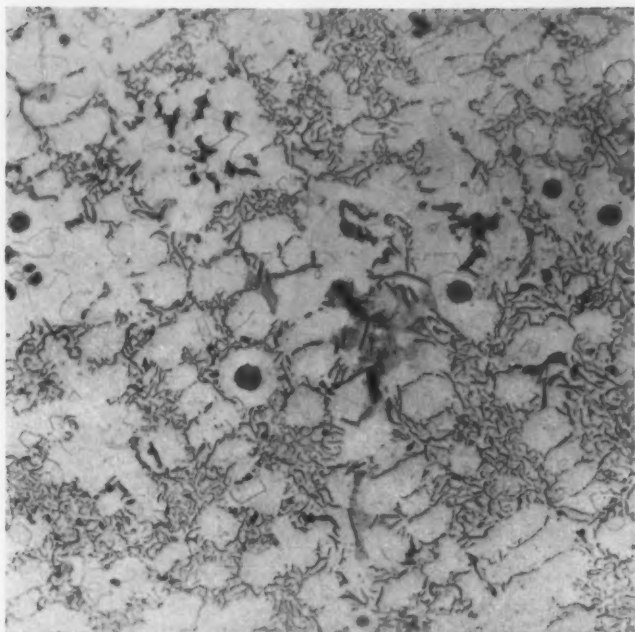


Fig. 7 — No. JO745 (nil Mn), sample No. 1, 0.0004% Mg. Shows Type-D graphite in the eutectic with spherulites occurring within the austenite dendrites. Etched—2% Nital. $\times 100$.

Figure 5, (a), (b) and (c) shows the effect, respectively, of insufficient, optimum and excessive magnesium content on graphite form in a hypo-eutectic iron. In Fig. 5 (a), also enlarged in Fig. 5 (d), there is considerable "quasi-flake" graphite, as termed by H. Morrogh, and in Fig. 5 (c), enlarged in Fig. 5 (e), there is beginning to appear a small amount of "spikey" graphite, or other inclusions, between the spherulites. It is considered that the occurrence of this phase contributes to the falling off of elongation values as indicated in Fig. 3.

In the so-called "nil manganese" hypo-eutectic heat the same pattern is evident, Fig. 6 (a), (b) and (c). Figure 6 (d) is an enlarged view of the "spikey" graphite occurring between the spherulites in Fig. 6 (c).

EUTECTIFORM GRAPHITE AND SPHERULITE IN THE SAME SAMPLE

Of special interest from theoretical consideration is sample 1 of Table 3 which had no addition of magnesium, although spectrographic analysis showed a magnesium content of 0.004 per cent, presumably reduced from the basic (magnesite) lined crucible.

Figure 7 shows that the graphite forms occurring in this sample consist of eutectiform, or Type D graphite, and well-defined spherulites occurring only in the austenite dendrites. Since it is well known that the eutectiform, or Type D graphite forms in the *last* freezing eutectic liquid, the spherulites occurring in the austenite dendrites *must* have formed previously, prior to the eutectic solidification, and probably in locally super-saturated zones produced during the first dendritic solidification. This mechanism of spherulite formation has been suggested by others.

The fact that in the very low manganese melt some spherulites occur at very low magnesium levels (none

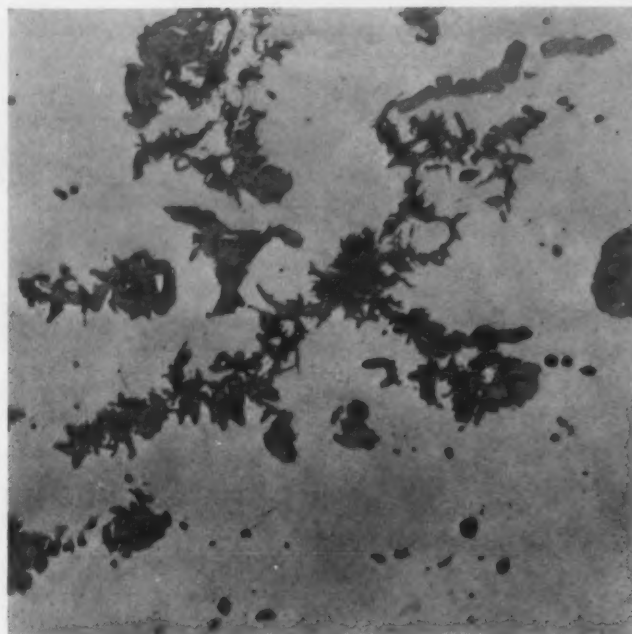


Fig. 8 — Effect of excessive magnesium on graphite structure of hypoeutectic ductile iron. Unetched. $\times 250$. Analysis: 0.26% Mg, 2.12% Si, 3.34% C, 0.02% S, 0.41% Mn, 0.04% P, 0.005% Sn, 0.001% Sb, 0.008% Pb.

added) lends some support to the senior author's previously made suggestion that the constituent manganese sulfide in some way tends to nucleate flake graphite; and that when manganese sulfide is absent, spherulites can occur. Note the relatively high strength values at low magnesium levels in Table 3 and in Fig. 2 and 3 for the "nil manganese" melt.

EXCESSIVE MAGNESIUM AND GRAPHITE FORM

As a further check on the effect of excessive magnesium discussed earlier, a sample was obtained from a hypo-eutectic iron which had been over-treated with magnesium in a pressure ladle. The deteriorated graphite structure found in this sample is shown in Fig. 8. A complete spectrographic study of this sample showed no appreciable content of "subversive" elements sufficient to cause this deterioration of the spherulitic structure. However, this iron had no inoculation treatment after the addition of pure magnesium, which treatment might have increased the proportion of spherulites.

GRAPHITE CLASSIFICATION

From the examples shown in this and other studies, it is obvious that there is a real need for a graphite classification chart to supplement the Joint AFS—ASTM chart for flake graphite (ASTM A247-47).

Figure 9 is a chart proposed by the Cast Iron Committee of the German Foundrymen's Association (Dr. A. Wittmoser, Chairman). VDG Data Sheet, July 1957, is reproduced by special permission. This chart shows the possible *types* of graphite associated with S. G. irons and would be used in conjunction with a supplementary *size* chart. It is believed that some of each of these suggested idealized graphite types have been shown in this study.

Tafel 3. Richtreihe für die Form von Kugelgraphit
(einschließlich Übergangsformen)

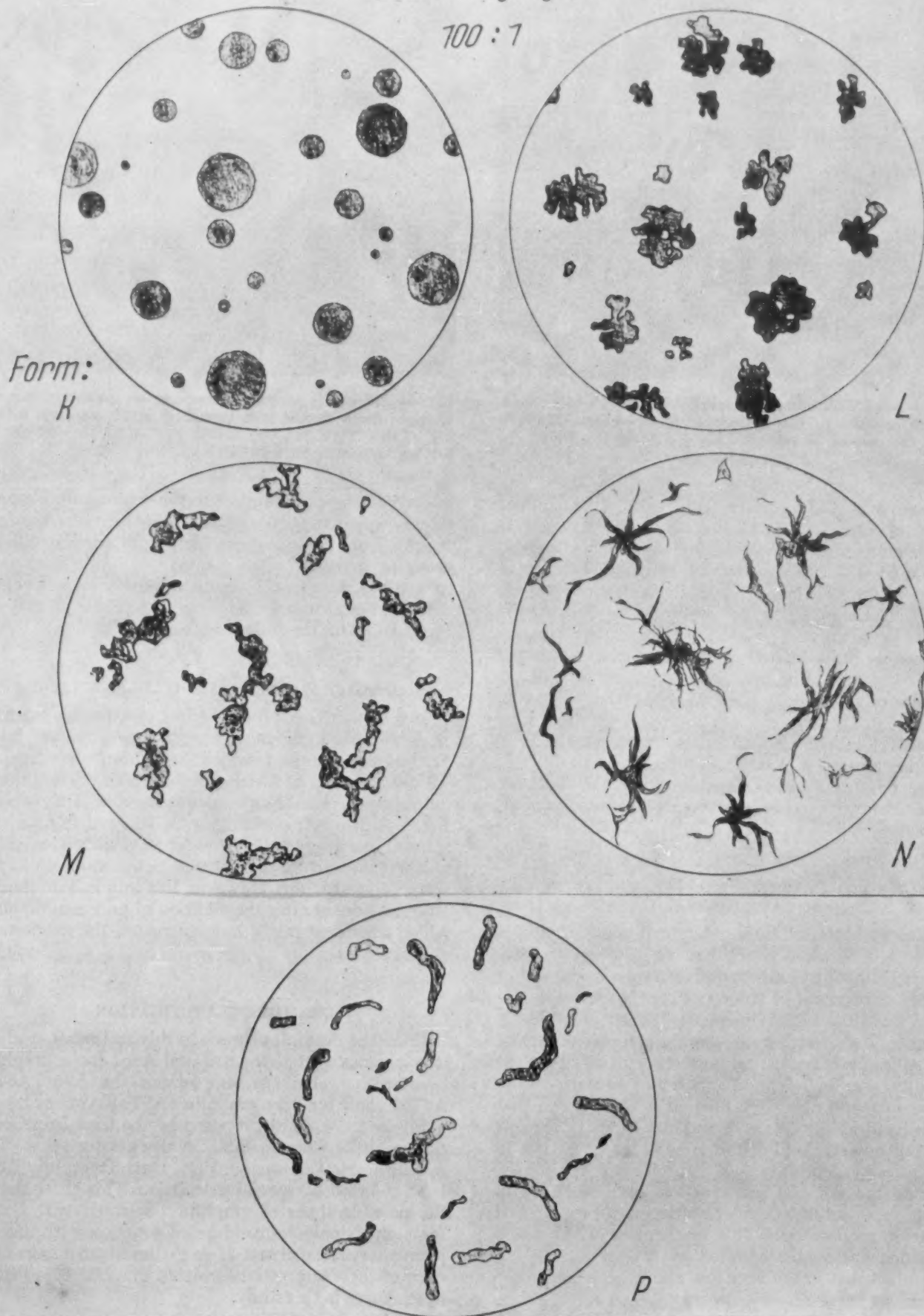


Fig. 9—Types of graphite shown in chart proposed by the Cast Iron Committee of the German Foundrymen's Association.

SUMMARY AND CONCLUSIONS

Although there are some obvious gaps in this study which point to the need for further work, the following tentative conclusions seem to be warranted:

- 1) In hyper-eutectic iron increasing magnesium causes a gradual disappearance of graphite flakes in favor of true spherulites.
- 2) In hypo-eutectic iron increasing magnesium causes the disappearance of true flake graphite in favor of "quasi-flake" graphite form, and then true spherulites.
- 3) In very low manganese hypo-eutectic iron, spherulites appear at a much lower magnesium level.
- 4) Excessive magnesium contents (over 0.14 per cent for the irons studied) cause the appearance of a

"spikey" graphite form with some deterioration of properties.

- 5) Where spherulites and eutectiform graphite occur together in hypo-eutectic iron, it is shown that the spherulites form first and are contained in the austenite dendrites.
- 6) A proposed German classification chart for graphite forms associated with spherulitic graphite irons is shown to compare reasonably with the various forms observed in this study.

ACKNOWLEDGMENTS

The authors wish to acknowledge the valuable help of W. A. Taylor and T. M. Scoonover of the American Cast Iron Pipe Co., Metallurgical Department.

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WRITTEN DISCUSSION IS SOLICITED

A METHOD OF CASTING RADIATOR-TYPE FUEL ELEMENTS FOR A NUCLEAR REACTOR

By

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INTRODUCTION

During the development of a reactor core for the Atomic Power Development Associates¹ Fermi fast-breeder reactor, one of the alternate fuel element designs was a radiator-type element which was in the shape of a regular hexagon 7-1/4 in. across the points and 30 in. long. The hexagon cross section of the fuel element was pierced with about 1027 coolant channels which were 0.165-in. in diameter and equally spaced on 0.195-in. diameter centers. The close spacing of the coolant channels gave the element a "honey-comb" appearance.

Thin-walled, stainless steel coolant tubes fitted into the coolant channels. Liquid sodium was to be sweated in between the fuel and the coolant tubes to insure an efficient transfer of heat from the fuel to the liquid sodium which flowed in the coolant tubes.

Because of the unique design of this element, it was quite apparent that it could be most readily fabricated either by machining or by casting techniques or by the use of both methods. It was proposed that this alternate fuel element be fabricated from the uranium-5 w/o chromium alloy, an eutectic alloy which is extremely fluid at melting temperature of 1640 F and therefore adaptable to casting techniques. Consequently, a program designed to determine the feasibility of casting the radiator type was initiated.

MELTING AND MOLDING

The melting and casting of the alloy was done in a vacuum induction furnace under pressure of 1×10^{-3} mm of mercury. High density graphite was used for the crucibles and molds. Molten uranium-5 w/o chromium alloy is quite reactive with the atmosphere and consequently, it is impractical to melt and cast this alloy in air. Therefore, it was necessary to employ the vacuum melting techniques and special mold materials for this alloy.

The vacuum induction furnace which was used had a capacity for a 30-lb melt of steel with a tilt-pour type crucible. This restriction naturally limited the size of the radiator-type elements which could be cast. Therefore, the size of the element to be studied was reduced from the original design size to a regular hexagon which measured 3.9-in. wide and was a maximum of 4-in. long.

A relatively complex graphite mold was designed to form the element. High density graphite was used because it could be machined to close tolerances and was relatively inert to the molten alloy.

The graphite mold consisted of three parts: the cavity assembly, the feeder assembly, and a retaining cup. The parts of the mold are shown in Fig. 1.

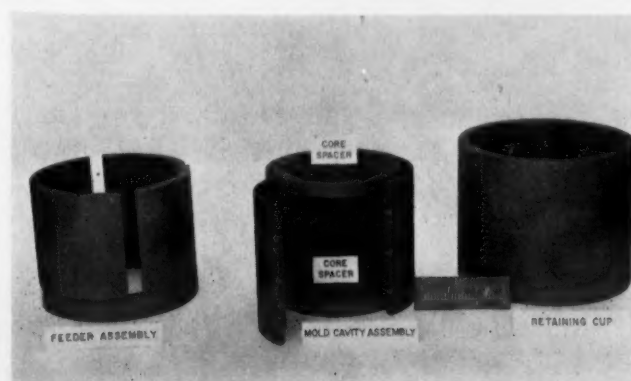


Fig. 1—Graphite mold consists of three parts.

(1) Atomic Power Development Associates, Inc. is a non-profit membership corporation chartered in the State of New York and supported by 34 electrical power systems, eight manufacturing enterprises, and four engineering organizations. The objective of APDA is the development of nuclear energy as a commercially practicable means of producing electric power. APDA sponsors research and development as part of its objective. A fast-breeder reactor of the APDA design is being constructed by the Power Reactor Development Company, a non-profit corporation chartered in the State of Michigan. According to present plans, the reactor will be built at the Enrico Fermi Power Plant of PRDC.

*Battelle Memorial Institute, Columbus, Ohio

The mold-cavity assembly formed the hexagon shape of the element and was fitted with a core spacer at the top and the bottom of the assembly. The core spacers aligned the cores which formed the coolant channels. Gates were positioned by drilling holes into this section of the mold.

The mold-cavity assembly was held together and positioned by the feeder assembly. The retaining cup contained both the feeder assembly and the mold-cavity assembly and held the split-type mold firmly together. A slot which was machined in the feeder assembly formed the downspout and was aligned with the gates in the mold-cavity assembly. When desired, several additional slots were made and these acted as risers in the mold. This type of mold, although somewhat complex, permitted various types of gating and risering techniques to be used without necessitating drastic change in the basic mold design.

CORES FOR CHANNELS

The mold for the prototype fuel element casting required 397 cores to form the coolant channels. Because no suitable core material for this type casting was known, a program was inaugurated for testing possible core materials. The results of this program showed that a 1/8-in. dia. stainless steel rod sprayed with a slurry of magnesium oxide in water to form a 10-mil coating was the best type of core material. It was necessary to protect the stainless-steel core rods from the molten uranium because of the eutectic reaction which occurs at 1332 F.

However, these cores did not possess the dimension tolerances required for the castings, and the removal of these cores from the castings was difficult and in some cases impossible. It was thought that if a uniform coating of magnesium oxide could be applied to the rod, the necessary dimensional tolerances could be met; and if the coating thickness could be increased, core removal would probably be much easier.

Two other methods of coating the stainless steel rods were investigated, dip coating and electrophoresis. Dip coating was unsuccessful. In the electrophoretic method, finely divided particles are suspended in a fluid medium and an electrical potential is applied to the system. The individual particles, under the influence of the electrical field, are charged and move to the electrode where their charge is dissipated leaving a film of particles deposited on the electrode.

After a cursory examination was made of the various electrolytes and magnesium oxide concentrations necessary to deposit nonporous uniform coatings on stainless steel rods, it was found that 400 gr of magnesium oxide in 600 cc of alcohol was the most efficient magnesium oxide concentration. A slurry which contained 1 weight per cent bentonite and 0.75 weight per cent ammonium hydroxide, based on the magnesium oxide content, served to increase the suspension of the larger particles in the bath and also to make the coating nonporous. Currents were generally held to be about 0.02-0.10 amperes and the voltage was maintained at about 110 volts DC.

With this process, the production of uniform core rods was relatively simple. Approximately 3600 core rods were made and used in the production of the

radiator-type castings. No trouble was encountered in maintaining 20-mil thick coating thicknesses on these rods to tolerances of ± 0.0005 in. None of these rods alloyed with the melt nor were they difficult to remove from the casting.

CASTING RESULTS

Six 2-in. high castings were made. The first 2-in. high casting which was attempted was unsuccessful because the mold did not fill completely. In subsequent castings, a graphite header tube, a tube 7-in. long and 3/4-in. in dia., was attached to the top of the mold. Using this header the remaining five castings were successfully produced. However, a few small shrinkage cavities were evident in the castings. These small cavities were thought to be caused by carbonate impurities in the magnesium-oxide coatings of the cores.

The first 2-in. high casting was poured at 1900 F into a heated mold which was at 1550 F. All other castings were poured at 2000 F into a heated mold which was at 1600 F.

In all of the castings knife gates, 1/4-in. wide by 2 in. high, were used to fill the mold cavity. Castings were made which used 1, 2, 3 or 4 knife gates to direct the molten metal into the cavity and in all cases the mold was completely filled. The molds which were poured with one gate were no different than a mold which used 4 gates. Figure 2 shows a typical 2-in. high casting after the mold and cores were removed. Figure 3 illustrates a casting after removal of the gates, sprues and cores. Figure 4 shows five 2-in. high castings stacked end to end with coolant tubes inserted through some of the coolant channels.

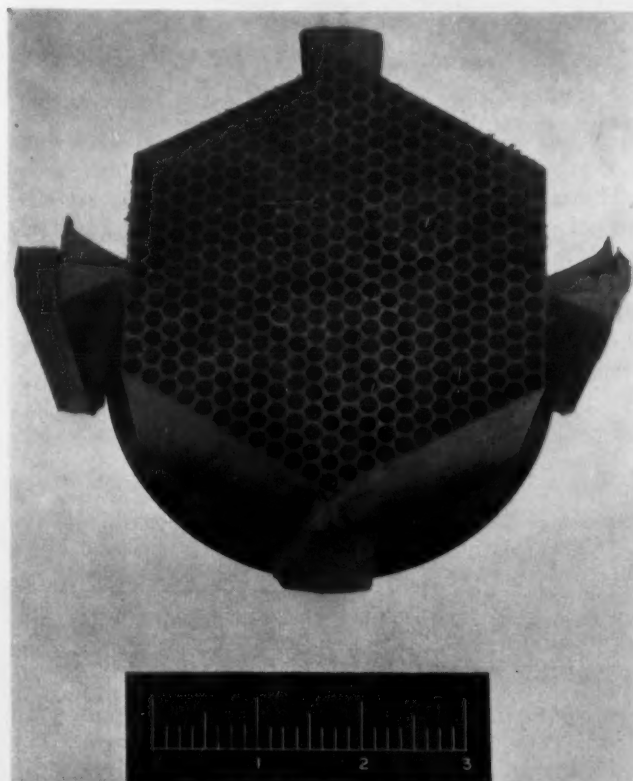


Fig. 2—Typical 2-in. high casting after mold and cores were removed.

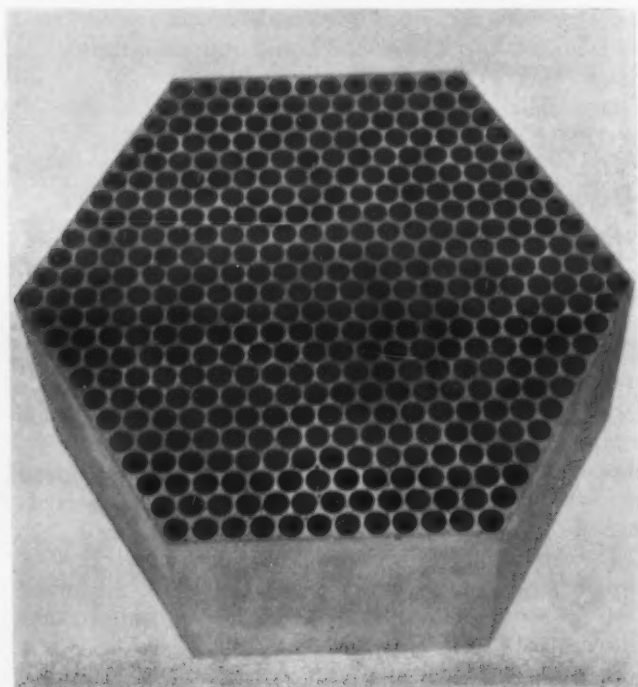


Fig. 3—Casting after removal of gates, spurs and cores.

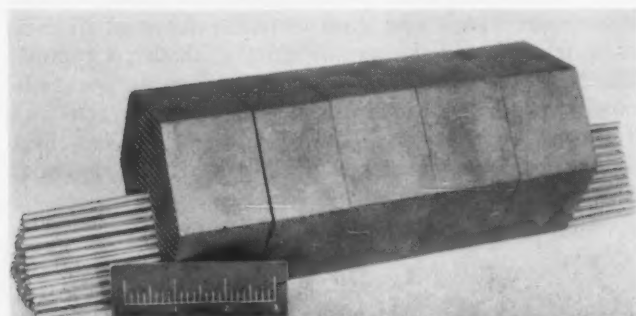


Fig. 4—Five castings end to end with coolant tubes inserted through some of the coolant channels.

The average measurement across the flats of the five successful castings was 3.891 ± 0.006 in. The graphite molds were designed to produce a casting which measured 3.910 in. across flat and was machined to tolerances of ± 0.005 in. Measurements of

the coolant channel diameters were taken on three typical castings. Average measurements for the coolant channels were 0.161 in., 0.161 in., and 0.160 in., respectively for the three castings. Spacing of the coolant channels was quite regular.

After casting a number of 2-in. high perforated hexagons successfully, three 4-in. high perforated hexagon castings were attempted. The casting conditions were identical with those for the 2-in. high hexagons, except that no header could be used with these larger castings because the facilities limited the amount of metal available for casting. The 4-in. high castings each required almost the maximum charge that the facilities would allow. Because a header could not be utilized in these larger molds the resultant castings were relatively porous at the top.

In all of the hexagonal castings, a few small shrinkage cavities were evident in the webbing between the coolant channels. These small defects were randomly dispersed throughout the castings and showed no relation to the ingates or to the top or bottom of the mold. One of the molds was preheated to 1800 F and then allowed to cool to 1600 F prior to pouring. This was done to bake out any impurities which might have been present in the oxide coatings of core rods and to thoroughly degass the graphite mold. Nevertheless, the casting produced in this mold still contained the shrinkage cavities. No further work was attempted to eliminate these small defects.

CONCLUSIONS

The casting of perforated-hexagon subsections which were 2 and 4 in. high and about 3.9 in. wide containing 397 perforations, 0.165 in. in diameter, was found to be quite practical. Optimum casting conditions for the chromium-uranium eutectic alloy were found to be a pouring temperature of 2000 F with a graphite mold temperature of 1600 F. Although the mold and the core costs for this melting and casting operation are relatively expensive when compared to normal melting practices, the fact that this shape could be cast makes possible the production of such a shape without the addition of excessive machining costs. Casting of larger sections of the perforated hexagon appears to be quite feasible, but the core-alignment problem probably would increase with an increase in the length of casting.

SOME REMARKS ON THE RELATIONSHIP OF INTERFACE TEMPERATURE AND SOLIDIFICATION

By

V. Paschkis* and J. W. Hlinka**

INTRODUCTION

In a paper presented at the 1957 meeting of the AFS, graphs were shown, indicating the time-temperature-space distribution in a slab during freezing, provided the surface of the slab is held at constant temperature.¹ This "constant surface temperature" can be visualized as the casting-mold interface, which during solidification remains nearly constant. The study showed that the value of the interface temperature between melt and mold has a marked effect on the rate of solidification; therefore an investigation was initiated to study the influence of interface temperature. To date work has been done only on pure metals (freezing at a constant temperature) rather than for alloys (freezing over a range). In the present paper some conclusions are reported. A nomenclature explaining the terms used in this paper is included in the Appendix.

Results are shown for iron, cast in sand or chill and two other molds. Of course, pure iron is not technically significant; yet the results should be of considerable interest because they hold, at least qualitatively, also for steel and are directly indicative of non-ferrous pure metals, such as aluminum, etc. But even more important, a generalized chart (Fig. 7) was developed which allows the determination of the total freezing time for a large slab (no end effects) of any pure material or eutectic alloy cast in a sufficient mold of any material, provided the conductivity of the solid casting is twice that of the liquid. This latter assumption probably holds for many metals.

DISCUSSION OF THE INTERFACE TEMPERATURE

General Comments

Most foundrymen will contend that the interface temperature between casting and mold, henceforth referred to as interface temperature, remains "practically constant" during solidification. Temperature indications are relevant only in connection with a

reference point: the centigrade scale uses the melting point of ice; the Rankine and Kelvin scales the absolute zero; the Fahrenheit scale an arbitrary value. If one selects the melting point of the metal as reference point, one finds that the interface temperature is by no means constant; in fact, under some conditions it varies greatly.

Figure 5 of the paper presented last year shows that if " U_s " (which is a measure of the interface temperature using the melting point as a reference) changes from 0.13 to 0.11, the solidification time (expressed as N_{re}^*) increases from 4.0 to 4.85; yet the change in U_s from 0.13 to 0.11 represents but a 12 degree F difference in the case of iron.

The value of U_s introduced in the previous study is the dimensionless temperature difference between the freezing temperature of the metal and the interface temperature. As shown, with this choice the interface temperature scale is greatly expanded and any deviation from the supposed constancy can be readily detected. Thus for clarity of presentation and comprehension of the effect of interface temperature on the solidification process, U_s is a potent means.

U_s is defined by Equation 1 in which:

- t_r is the melting (fusion) temperature of the metal (F)
- t_i is the interface temperature (F)
- c is the specific heat of the metal (Btu/lb, F)
- λ is the heat of fusion of the metal (Btu/lb)
- $U_s = (t_r - t_i) c / \lambda$ (1)

Additional dimensionless temperature definitions are for:

- a) the pouring (bath) temperature expressed in dimensionless terms is a measure of the superheat:

$$U_b = (t_b - t_r) c / \lambda$$
 (2)
- b) the mold temperature expressed in dimensionless terms is:

$$U_m = (t_r - t_m) c / \lambda$$
 (3)
 where t_b and t_m are the initial temperature of the bath and mold respectively.

The problem considered in this investigation can be described as the casting of a plane plate of finite thickness; the surface area of the plate is so great

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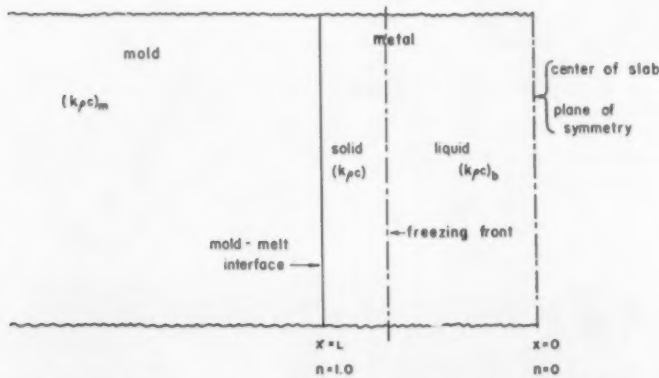


Fig. 1—Geometry and boundary conditions in casting a plate.

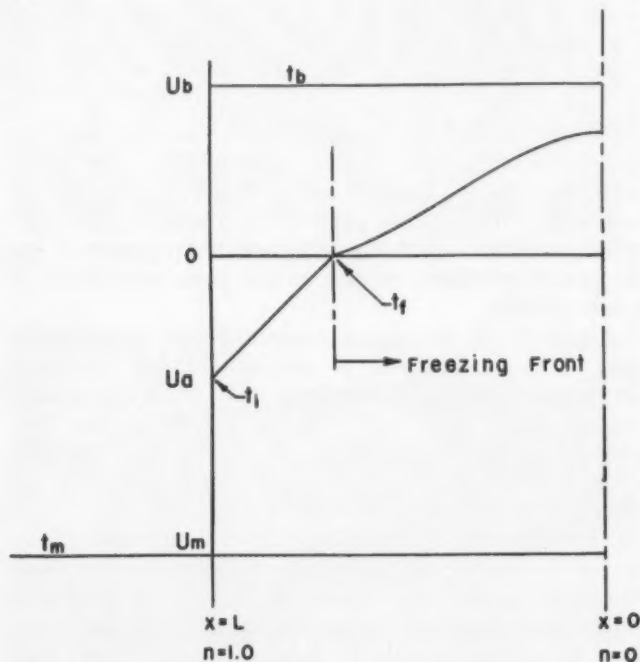


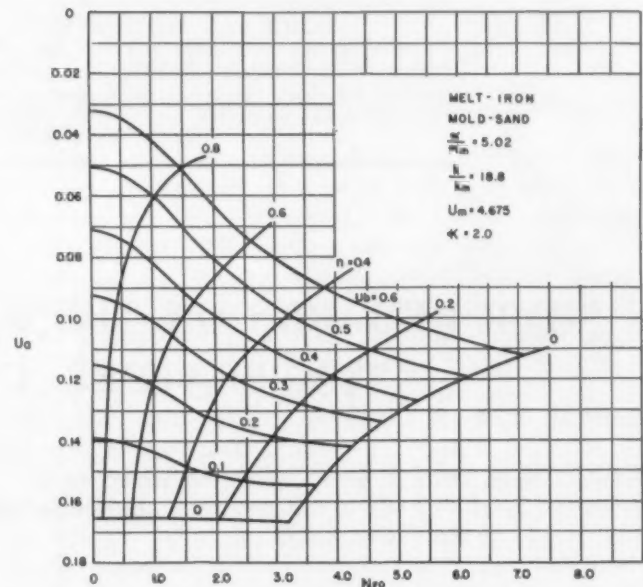
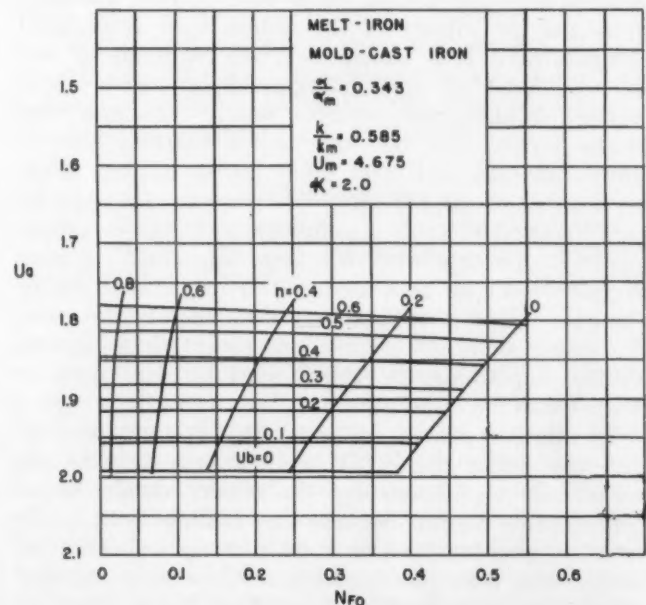
Fig. 2—Temperature notations for casting a plate.

that end effects may be neglected. The plate is cast (zero filling time is assumed) in a "sufficient" mold; i.e., a mold of sufficient thickness such that cooling from the outside (through the flask) is significant.¹ Figure 1 shows the geometry and boundary conditions whereas Fig. 2 indicates the temperature notation.

In all cases the conductivity of the liquid metal is assumed to be one-half that of the solid metal, whereas the volumetric specific heats of solid and liquid are assumed equal. Before the melt is brought into contact with the mold the former has a uniform and constant initial temperature described by U_b , while the constant initial temperature of the mold is defined by U_m . At time zero the melt and mold are brought into contact and cooling begins.

In most cases U_a will be continuously positive; but with high superheat, and under certain other conditions discussed below, U_a may be initially negative;

¹ Theoretically results apply also to a thinner mold, provided the temperature gradient of the mold at the interface is at all times the same in the sufficient mold.

Fig. 3—Characteristic curves of U_a for iron freezing in a sand mold.Fig. 4—Characteristic curves of U_a for iron freezing in an iron mold.

thus the original interface temperature can be higher than the melting point. While more results will be shown later, Fig. 3 and 4 are characteristic curves of U_a for iron freezing in a sand mold and a chill mold respectively. Time (on the horizontal axis), is plotted in terms of " N_{Fo} ", and defined by Equation 4 in which the following designations are used:

- τ = time (hr)
- L = half-thickness of the casting (ft)
- k = thermal conductivity (Btu/ft, hr, F)
- c = specific heat (Btu/lb, F)
- $\alpha = (k/\rho c)$ thermal diffusivity (sq ft/hr)
- ρ = density (lb/cu ft)
- $N_{Fo} = \alpha \tau / L^2$ (4)

Also, cross plotted on these curves are the freezing plane position lines marked "n". The term "n" is de-

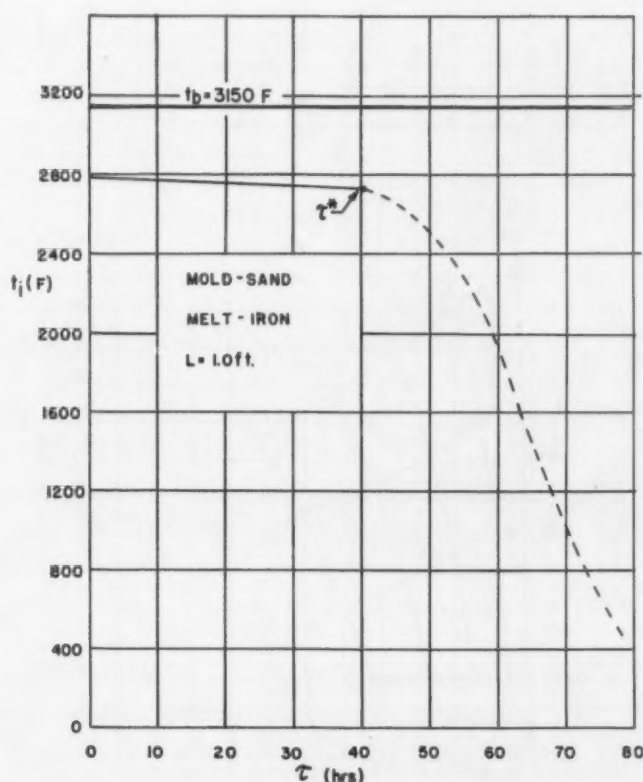


Fig. 3a—Interface temperature vs time for sand mold.

defined as the ratio of the real position x (measured from the center of the slab (see Fig. 1) to the half-thickness L of the plate. The intersection of the dimensionless "n" curves, with the U_a vs N_{Fo} curve gives the time, N_{Fo} , at which the freezing plane reaches the position "n" in the slab. The chill mold results in much more constant U_a than does the sand mold. An example will illustrate the point made above regarding the temperature scale; the actual interface temperatures are plotted against time after pouring in Fig. 3a and 4a, for the following set of properties:

Iron poured at	3150 F		
Melting point	2800 F		
Mold temperature	70 F		
Thickness of cast	1 ft		
	Iron	Sand Mold	Chill Mold
Thermal conductivity	16.93	0.9	29.0
Specific heat	0.20	0.28	0.12
Density	492.0	93.6	484.0
Heat of fusion	116.8	...	...

While (in the case of the sand mold) U_a drops $\frac{100(0.111 - 0.032)}{0.032} = 250$ per cent (from Fig. 3), the

temperature, in degrees drops only $\frac{100(2781 - 2735)}{2781} = 1.65$ per cent (from Fig. 3a).

Factors Controlling U_a

Equation 1 defining U_a does not explicitly show all factors contributing to the value which U_a will take in a given casting operation. These factors are:

Casting properties:
(both for solid and liquid state)

conductivity
specific heat
density
latent heat of fusion
melting point
conductivity
specific heat
density

Mold properties:

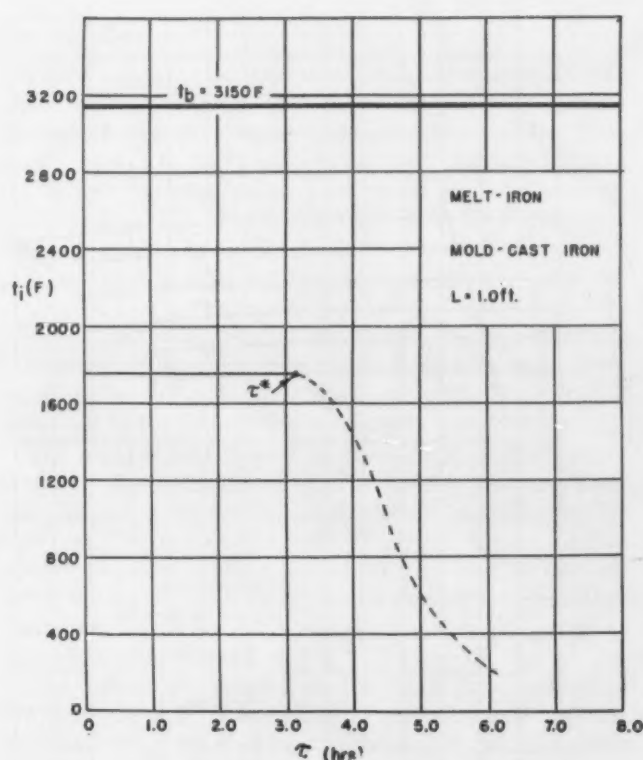


Fig. 4a—Interface temperature vs time for iron mold.

Operating conditions:

casting thickness
pouring temperature
initial mold temperature

As shown above, U_a may change during solidification, and one point of interest is to find out to what extent U_a does change. The initial value of U_a can be computed because in the first instant of contact the interface "does not know" how thick the casting is, so that it acts as if it were infinite in thickness, for which case analytical equations are available². Initially one of two conditions can occur:

The initial interface temperature can be above or below the melting point. If the superheat is such that the initial interface temperature is above the melting point, the interface temperature is defined by the "Riemann temperature"³, expressed by Equation 5, in which subscripts b and m stand for bath (pouring) and mold respectively, t for temperature, and the other notations are as in Equations 1-4.

$$t_i = \frac{t_b \sqrt{(k\rho c)_b} + t_m \sqrt{(k\rho c)_m}}{\sqrt{(k\rho c)_b} + \sqrt{(k\rho c)_m}} \quad (5)$$

In terms of the dimensionless temperatures U_a , Equation 5 may be written:

$$U_a = \frac{U_m \sqrt{(k\rho c)_m} - U_b \sqrt{(k\rho c)_b}}{\sqrt{(k\rho c)_m} + \sqrt{(k\rho c)_b}} = \frac{U_m - \beta U_b}{1 + \beta} \quad (6) \text{ where}$$

$$\beta = \frac{\sqrt{(k\rho c)_b}}{\sqrt{(k\rho c)_m}} = \beta / \sqrt{K} \quad (7)$$

If t_i thus computed is smaller than t_f , the heat of fusion (which does not appear in Equations 5 or 6) must be considered.

The interface temperature can no longer be found from an elementary equation; in fact without resort to very cumbersome procedures a method of succes-

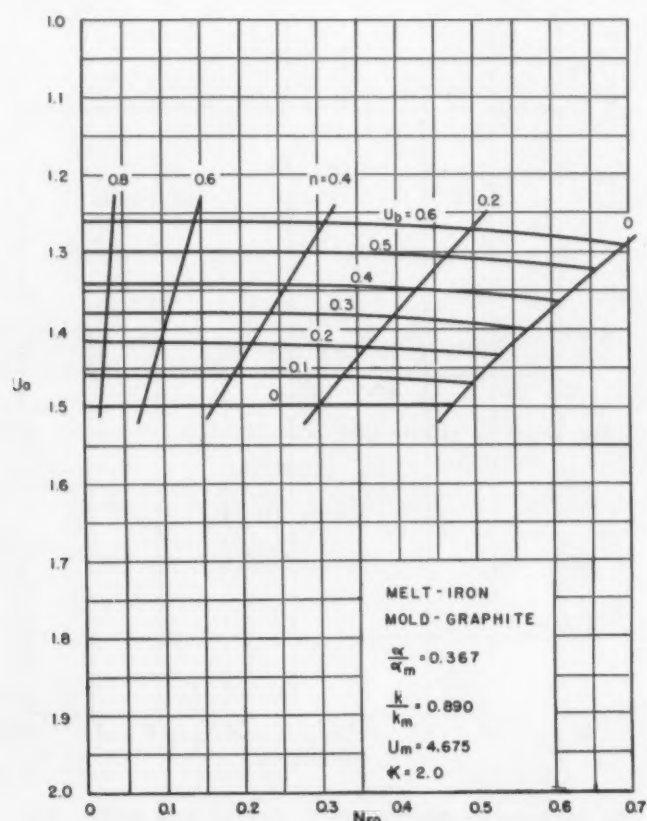


Fig. 5—Characteristic curves of U_a for iron freezing in a graphite mold.

sive approximation appeared most appropriate for the determination of the initial value of U_a . This method is greatly simplified by a graph, Fig. 9, shown in the Appendix together with the derivation.

Mold Materials and U_a Values

In Fig. 3 and 4 the change of U_a with time was shown for iron cast in a sand mold and a chill mold respectively. The shape of the U_a curves was so different that other mold materials were investigated, and results are shown in Fig. 5 and 6. Figure 5 holds for a graphite mold, Fig. 6 for a mold somewhere between graphite and sand in its heat extracting properties.

Figures 3 to 6 can be interpreted for metals other than iron, as discussed in the next section. But if the melting metal is iron, then the mold materials for Fig. 3-6 are characterized by the following properties:

	"Good conducting" sand		Graphite Chill	
	Fig. 3	Fig. 6	Fig. 5	Fig. 4
Conductivity Btu/ft, hr, F	0.9	4.5	19	29.0
Specific heat Btu/lb, F	0.28	0.28	0.29	0.12
Density lb/cu ft	93.6	93.6	140	484

A comparison of Fig. 3-6 is revealing. As expected, on all four charts every curve starts at the value of U_a as computed according to the Appendix. The drop of U_a during freezing depends on the superheat (U_b) and the mold. Freezing in a cast iron mold takes place with an almost constant U_a (i.e., an almost constant interface temperature) even at relatively high values of U_b while the other molds show a drop

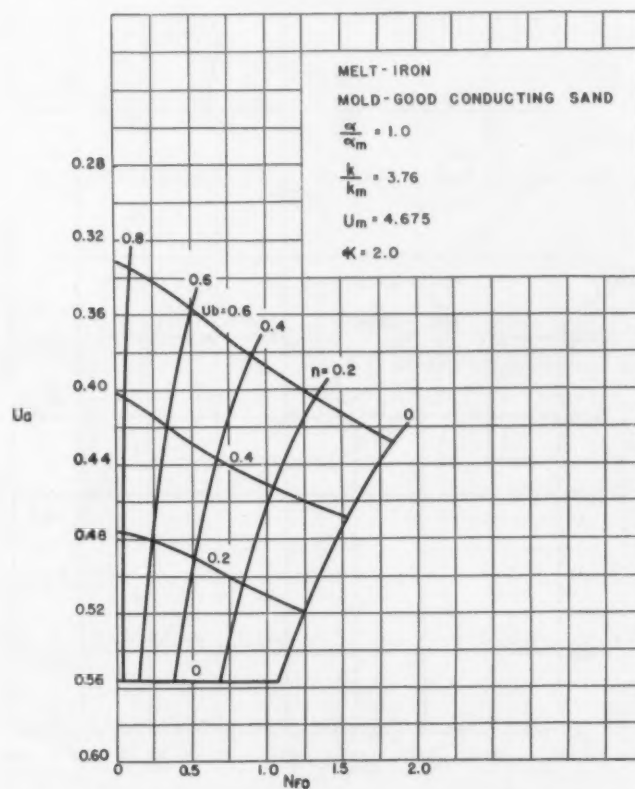


Fig. 6—Characteristic curves of U_a for iron freezing in a good conducting sand.

of U_a with time; a drop which is more severe in the case of "poorer conducting" molds than in "good conducting" molds.

It is well to remember that the steepness is accentuated by selecting in U_a the melting point of the metal as the reference point of the temperature scale. Now, it may appear surprising that the interface temperature drops least in case of a good conducting mold. The explanation lies in the fact that the initial value of U_a is highest in the case of the chill mold and decreases as one considers "poorer conducting" molds.

Significance of the Dimensionless Interface Temperature U_a

If, as was shown earlier in the paper, determinations of U_a entail determinations of the interface temperature, why, one can ask, go to the trouble of working with a dimensionless quantity. Its use, it appears, may result in two possible advantages; use of U_a allows, as is shown in the section of this report "Generalized Solidification Rates," a quite general presentation of freezing times in slabs; and the concept of U_a may well lead to a generalized presentation of the temperature distribution in the casting.

These advantages seem sufficient to justify the extra work involved in dealing with this abstract concept; particularly in light of the possibility of predicting total freezing times for slabs of any material freezing in molds of any material.

Interpretation of Curves for Different Metals

The curves Fig. 3-6 represent also the solidification of metals other than iron. But if the thermal properties

of the casting are selected, those of the mold, as well as pouring temperature, etc., may come out in values which are impractical, as will be shown below for the case of aluminum. This does not speak against the use of dimensionless ratios but only shows that more curves are required for a general representation. Consider the curves to be valid for aluminum, having properties of:

Thermal conductivity	$k = 128 \text{ Btu/ft, hr/F}$
Specific heat	$c = 0.22 \text{ Btu/lb/F}$
Density	$\rho = 170 \text{ lb/cu ft}$
Latent heat	$\lambda = 170 \text{ Btu/lb}$
Melting point	$t_f = 1220 \text{ F}$

Then the mold properties for each of the four figures would have to be as shown in Table 1.

TABLE 1 - MOLD PROPERTIES REQUIRED TO COMPLETELY VALIDATE FIG. 3-6 FOR AN ALUMINUM MELT

Fig.	k_m	α_m
3	6.8	0.68
4	219.0	10.0
5	144.0	9.32
6	34.3	3.42

Next, in order to satisfy the same value of U_b the initial metal temperature would have to be as in Table 2; for the sake of comparison the values for iron are added.

TABLE 2 - INITIAL TEMPERATURES

U_b	Initial temperature, (F)	
	Iron	Aluminum
0.0	2800	1220
0.2	2917	1375
0.4	3034	1525
0.6	3151	1675

Finally, in order to result in the same values of U_m as used before the initial mold temperatures would have to be as follows: for the sake of comparison the values for iron as melt material are added.

TABLE 3 - INITIAL MOLD TEMPERATURE

U_m	Mold temperature, (F)	
	Iron	Aluminum
4.675	70	-2330

Cooling the mold to below absolute zero is of course physically meaningless; as indicated above, the conclusion is that those four charts are not applicable to aluminum. A non-preheated mold (initial temperature 70 F) would give for aluminum a value of

$$U_m = 0.22 (1220 - 70) / 170 = 1.49$$

GENERALIZED SOLIDIFICATION RATES

Contributions to Initial Value of U_a

As mentioned before the initial value of U_a depends solely on the nature of the casting and of the mold and on the respective initial temperatures. Thus for any given material to be cast, e.g., iron or aluminum the same value for the initial U_a can be obtained for different mold materials by selecting appropriate values of, say, the bath temperatures.

General Plot

One can now plot the total freezing time (i.e. the time required for the center of the slab to freeze) against the initial value, designated U_{ai} of U_a . One would expect to find separate curves, each one holding for a specific combination of mold-melt, superheat, mold preheat, etc. But surprisingly this is not the case, and all values fit a single set of curves (within 5 per cent) as shown in Fig. 7. This chart is a result of many computations not presented here for lack of space and represents an aggregate of approximately 170 casting determinations in which the mold temperatures were varied to extremes for both silver and iron, cast in the four molds previously tabulated.

The authors feel, based on the almost perfect correlation of the data, that Fig. 7 holds for any combination of the parameters (conductivities and specific heats of castings and mold, heat of fusion, initial temperatures of casting and mold), as long as the value of $K = 2$ is used. It would be desirable by further studies to increase the present range of the chart to include higher values of N_{Fo}^* .

The figure was organized for clear presentation of the data and ease of handling; thus instead of U_{ai} the ordinate $U_{ai} + U_b$ was chosen to give positive slopes to the N_{Fo}^* lines over the entire range; whereas the choice of $U_{ai} + U_b$ vs U_b (instead of $U_{ai} + U_b$ vs N_{Fo}^*) yields the characteristic straight lines. To recapitulate, Fig. 7 gives the total freezing time for a slab of great surface area but finite thickness, for any casting material, any mold material, any degree of superheat, and any degree of mold preheat or mold

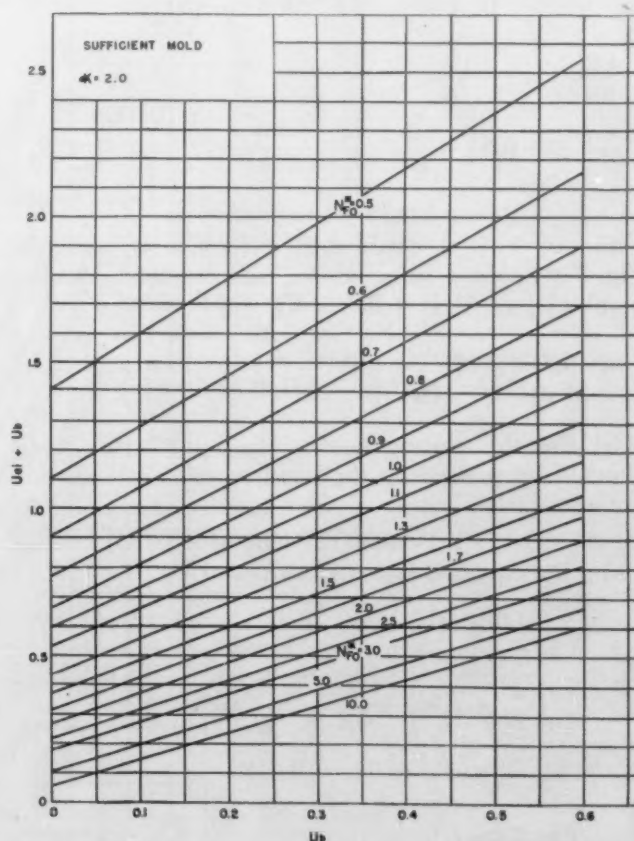


Fig. 7—Relationship of total freezing time for center of casting to freeze vs pouring and interface temperatures when $K = 2$.

cooling; the only restriction is that the mold be "sufficient" (i.e. that its outer surface does not lose heat appreciably during the solidification time), and that the liquid conductivity of the melt may be assumed to be one-half of the solid conductivity.

Examples of Application

To show the usefulness of this presentation, a number of illustrative examples are carried through. Without further explanation "freezing time" will always indicate the time required for the center to reach the melting point.

a) for iron. (properties as above): total slab thickness 12 in., what is the freezing time in a sand mold, if the iron is poured at 3150 F and the mold is initially at 70 F?

$$\text{Then } U_b = (c/\lambda)(t_b - t_s) = 0.00171(3150 - 2800) = 0.6$$

$$U_m = (c/\lambda)(t_s - t_m) = 0.00171(2800 - 70) = 4.67$$

$$\beta = \sqrt{\frac{k\rho c}{(k\rho c)_m}} = \sqrt{\frac{(16.9)(492)(0.2)}{(0.9)(93.6)(0.28)}} = 8.4$$

The procedure by which U_{ai} is found is described in the Appendix; however, a sand mold will generally yield sufficiently small values of U_{ai} to warrant use of the equation presented with Fig. 9.

Thus,

$$U_{ai} = \frac{\frac{U_m}{\beta} - \frac{U_b}{\sqrt{2}}}{\frac{\beta}{U_m} \left(\frac{\pi}{2} + U_b \right) + \frac{2}{\beta} - \frac{U_b}{\sqrt{2} U_m}} = \frac{\frac{4.67}{8.4} - \frac{0.6}{\sqrt{2}}}{\frac{8.4}{4.67} \left(\frac{\pi}{2} + 0.6 \right) + \frac{2}{8.4} - \frac{0.6}{\sqrt{2}(4.67)}} = 0.0326$$

$$\text{and } U_{ai} + U_b = 0.0326 + 0.6 = 0.633$$

with $(U_b + U_{ai})$ established, reference is made to Fig. 7 whence a value of N_{Fo}^* is obtained. At the point $(U_{ai} + U_b) = 0.633$, $U_b = 0.6$ read,

$$N_{Fo}^* = 7.0$$

$$\text{Since } (L^2/\alpha) = (6/12)^2 (1/0.172) = 1.45$$

$$\tau = (L^2/\alpha) N_{Fo}^* = (7.0)(1.45) = 10.2 \text{ hr}$$

b) For this casting how is the solidification time affected by preheating the mold to 460 F? With this preheat

$$U_m = (c/\lambda)(t_s - t_m) = (0.2/117)(2800 - 460) = 4.0$$

Using the equation for small values of U_{ai}

$$U_{ai} = \frac{\frac{4.0}{8.4} - \frac{0.6}{\sqrt{2}}}{\frac{8.4}{4.0} \left(\frac{\pi}{2} + 0.6 \right) + \frac{2}{8.4} - \frac{0.6}{\sqrt{2}(4.0)}} = 0.011$$

$$U_{ai} + U_b = 0.011 + 0.6 = 0.611$$

From Fig. 7 read:

$$N_{Fo}^* = 9.5$$

$$\tau = N_{Fo}^* (L^2/\alpha) = (9.5)(1.45) = 13.8 \text{ hr}$$

c) What would be the solidification time if the slab is cast in a cast iron mold at 70 F?

$$U_b = 0.6$$

$$U_m = 4.67$$

$$\beta = \sqrt{\frac{k\rho c}{(k\rho c)_m}} = 1.0$$

For this case U_{ai} is large; therefore it is determined according to the successive approximation procedure described in the Appendix.

$$\text{From Fig. 9 } U_{ai} = 1.78$$

$$\text{and } U_{ai} + U_b = 1.78 + 0.6 = 2.38$$

From Fig. 7

$$N_{Fo}^* = 0.54$$

$$\tau = (0.54)(1.45) = 0.784 \text{ hr}$$

d) An aluminum slab is poured in a cast iron mold at 70 F with a pouring temperature of 1375 F. The total slab thickness is 8 in.

$$U_b = (0.22/170)(1375 - 1220) = 0.2$$

$$U_m = (0.22/170)(1220 - 70) = 1.485$$

$$\beta = \sqrt{\frac{(128)(169)(0.22)}{(29)(484)(0.12)}} = 4.83$$

From Fig. 9: $U_{ai} = 0.027$

$$\text{and } U_{ai} + U_b = 0.227$$

From Fig. 7: $N_{Fo}^* = 10.0$

$$\text{with } L^2/\alpha = (4/12)^2 (1/3.4) = 0.0327$$

$$\tau = (10.0)(0.0327) = 0.33 \text{ hr}$$

USEFULNESS

The chart, Fig. 7, allows the determination of the freezing time of any slab. If the mutual influence of the two parts of the casting shown in Fig. 8 is disregarded, the progress of solidification in the two parts can be determined. In order to get uniform freezing the thinner part may require preheating of the mold, or other mold material. Consider iron cast in sand. Assuming the criterion for a sound casting is that the 6-in. thick section should freeze no faster than the 12-in. thick part, several possibilities can be analyzed from the data presented above: for instance, keep the mold material facing A and B the same, but preheat the part facing B; or keep the initial mold temperature uniform but use different mold materials.

Assuming, for slab A, a sand mold and other conditions as in the previous section, problem (a), the dimensionless freezing time was determined as:

$N_{Fo}^* = 7.0$, yielding a real solidification time of 10.2 hr. If slab B were also cast in sand the dimensionless freezing time remains $N_{Fo}^* = 7.0$ but the time in hours, due to the different thickness would be: $\tau = (N_{Fo}^*)(L^2/\alpha) = 7.3(3/12)^2(1/0.172) = 2.55 \text{ hr}$ i.e., $\tau = 10.2(3/6)^2 = 2.55 \text{ hr}$

To make slab A freeze in 2.55 hr the required N_{Fo}^* is $N_{Fo}^* = \alpha\tau/L^2 = (0.172)(2.55)/(12/6)^2 = 1.75$

From Fig. 7 for $N_{Fo}^* = 1.75$, $U_b = 0.6$

$$\text{find; } U_{ai} + U_b = 0.96$$

$$U_{ai} = 0.36$$

From Fig. 9 with $U_{ai} = 0.36$

$$\text{find } \beta/(U_m - 1) = 0.30$$

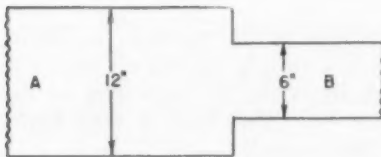


Fig. 8—Slab casting with two different cross-sections.

Now write the latter expression which defines the abscissa in Fig. 9 in physical terms rather than in dimensionless ones:

$$\frac{\beta}{\frac{U_m}{U_{ai}} - 1} = \frac{\sqrt{k\rho c}}{\sqrt{k\rho c_m} \left(\frac{c(t_f - t_m)}{0.36\lambda} - 1 \right)} = 0.30$$

Rearranging and substitution of the casting properties yields

$$\frac{\beta}{\frac{U_m}{U_{ai}} - 1} = \frac{8400}{\sqrt{(k\rho c)_m} (2590 - t_m)} = 0.30$$

$$(2590 - t_m) = 28000 / \sqrt{(k\rho c)_m} \quad (8)$$

This equation shows the relationship between the initial mold temperature and the mold properties required to obtain a 2.55 hr freezing time in slab A. If one wishes to pre-cool a sand mold having the same properties as the sand facing slab B, the required

temperature of the mold is

$$t_m = 2590 - 28000 / (0.9) (93.6) (0.28) = -3160 \text{ F}$$

If pre-cooling is undesirable (or impossible as in this case) a different mold may be computed. If t_m is to be maintained at room temperature Equation 8 yields a mold with

$$\sqrt{(k\rho c)_m} = \frac{28000}{(2590 - 70)} = 11.1$$

$$(k\rho c)_m = 123.$$

Thus a mold material having a product of conductivity and volumetric specific heat of 123 would permit both slabs to completely solidify at the same time, namely 2.55 hr. Additional manipulations of Equation 8 for purposes of investigating the optimum casting procedure in this particular example would be to (1) decrease the solidification time of slab A and increase the solidification time of B to some intermediate time by choosing another mold material for slab B. (2) Preheat or precool differently the two parts of the mold.

FURTHER WORK

The correlation, permitting the expression of freezing times in terms of the initial interface temperature is so simple and inclusive that a number of further steps suggest themselves.

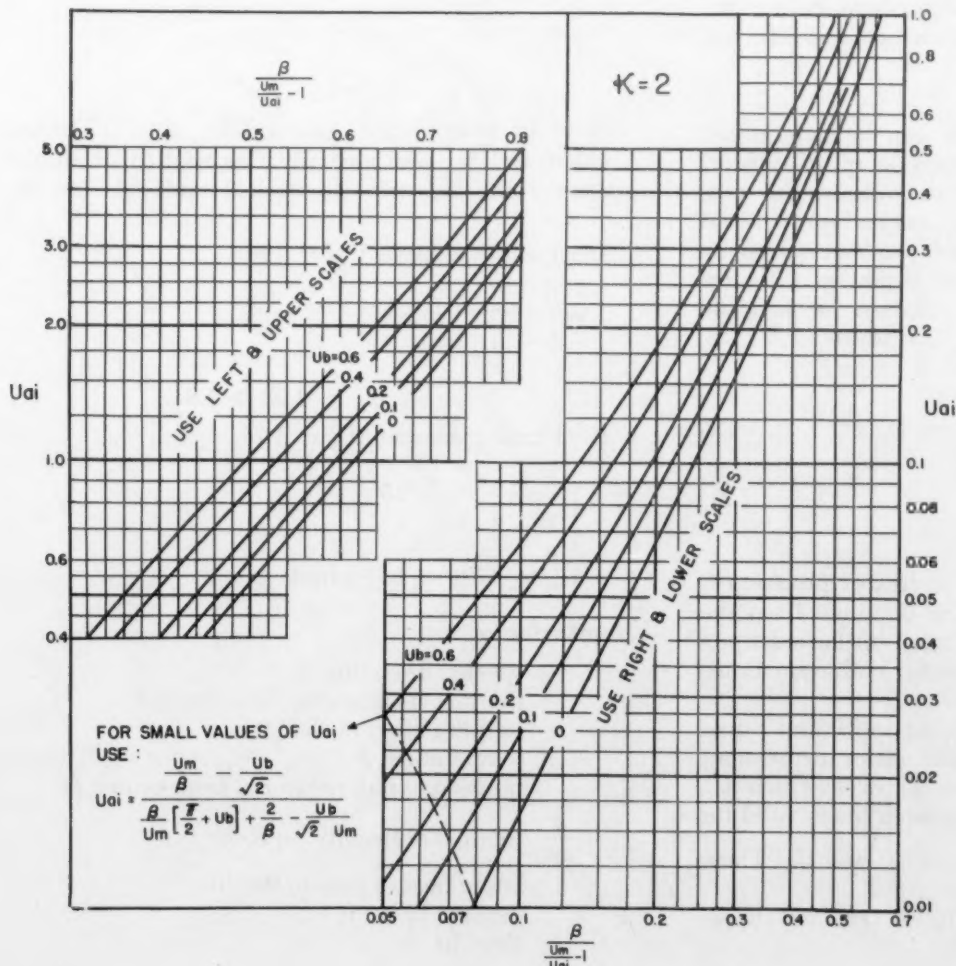


Fig. 9—Chart used in calculating time required for center of casting to reach the melting point.

- 1) Investigate more fully the cases having conditions such that the initial interface temperature is above the melting temperature.
- 2) Set up similar charts for the case of equal conductivities of the liquid and solid metal.
- 3) Explore influence of limited mold thickness, including outside heat losses and interface air gaps caused by casting shrinkage.
- 4) Extend work to cover alloys freezing over a range.
- 5) Connect the relation of total freezing time with the expressions for temperature distribution, shown in last year's paper.
- 6) Extend work to cover other shapes.
- 7) Relate results, particularly of present work and of items 1, 2, and 5 above with riser dimensions.

ACKNOWLEDGMENTS

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Calculations on the heat and mass flow analyzer were carried out by Ovid Tino and George Ziener.

APPENDIX

Determination of Initial Value of the Interface Temperature (Provided the Initial Interface Temperature is below the Solidification Point).

If Equation 5 results in a temperature below the solidification temperature the following procedure applies:

1) Equations

The initial interface temperature can be determined analytically²; however the solution is quite difficult because a constant "a", which determines the progression of the freezing plane, need be extracted from complicated equations which are best solved by trial and error. Equation (9) and Equation (10) are the defining equations for the constant "a" and the initial interface temperature, U_{ai} , in terms of U_m , B , and U_b .

$$\frac{U_m e^{-a^2}}{\beta + \operatorname{erfa}} - \frac{U_b e^{-2a^2}}{\sqrt{2}(1 - \operatorname{erf}\sqrt{2}a)} = a\sqrt{\pi} \quad (9)$$

$$U_{ai} = \frac{U_m \operatorname{erfa}}{\beta + \operatorname{erfa}} \quad (10)$$

These equations are to be used if greater precision is required than that which may be obtained from the use of Fig. 9. The constant "a" may be looked upon as any number which will satisfy both equations; once "a" is determined, U_{ai} follows.

When U_{ai} is sufficiently small, Equation (9) and Equation (10) may be expanded into series expressions and simplified, forming Equation 11 from which U_{ai} may be determined directly. This equation is valid for certain combinations of $\beta/\left(\frac{U_m}{U_{ai}} - 1\right)$ and U_b . These combinations are marked in Fig. 9 (see left lower side).

2) Use of Fig. 9

Figure 9 is a graphical aid to the solution of Equations 9 and 10. Its use is a simple and direct trial and error procedure which bypasses the necessity of determining the constant "a". The use of this figure is best explained by an example.

a) In the Section entitled "Generalized Solidification Rates" example c) the following casting conditions prevailed:

$$U_b = 0.6$$

$$U_m = 4.67$$

$$\beta = 1.0$$

For this case determine U_{ai}

(i) Assume arbitrarily value of U_{ai} , e.g. $U_{ai} = 1.0$

$$\frac{\beta}{\frac{U_m}{U_{ai}} - 1} = \frac{1}{\frac{4.67}{1.0} - 1} = 0.272$$

From Fig. 9 read for the curve $U_b = 0.6$ and the abscissa of 0.272 an ordinate of

$$U_{ai} = 0.30.$$

This is less than the assumed value of $U_{ai} = 1.0$ and a new value of U_{ai} is to be assumed.

(ii) As second trial assume $U_{ai} = 2.0$

From Fig. 9 and the $U_b = 0.6$ curve, using the insert read, at

$$\frac{\beta}{\frac{U_m}{U_{ai}} - 1} = 0.75$$

$$U_{ai} = 3.70 > 2.0$$

Note in trial (i) the assumed U_{ai} was above the calculated U_{ai} and vice versa in trial (ii); thus the answer lies between U_{ai} of 1.0 and 2.0. (iii) As

third value assume $U_{ai} = 1.8$

$$\frac{\beta}{\frac{U_m}{U_{ai}} - 1} = 0.625$$

$$U_{ai} = 1.92 > 1.8$$

(iv) Finally, assume $U_{ai} = 1.78$:

$$\frac{\beta}{\frac{U_m}{U_{ai}} - 1} = 0.615$$

$$U_{ai} = 1.78 = 1.78 \text{ check.}$$

Nomenclature

c	specific heat, Btu/lb, F
k	thermal conductivity, Btu/hr, ft, F
L	half-thickness of slab, ft
t	temperature, F
x	position in slab measured from center, ft
α	$\frac{k}{\rho c}$ thermal diffusivity, sq ft/hr
λ	latent heat of fusion, Btu/lb
ρ	density, lb/cu ft
τ	time, hr

Property Subscripts

Lack of subscript refers to solid state metal properties.

b liquid state properties

m mold properties

Temperature Subscripts

b pouring or bath temperature; i.e., initial temperature of melt

f freezing or melting point of casting

i interface temperature between melt and mold

m mold temperature, initially

Dimensionless Notation $n = x/L$ dimensionless position in slab $N_{Fo} = \alpha \tau / L^2$ dimensionless time with reference to solid state properties and half-thickness of slab $N_{Fo}^* = \alpha \tau^* / L^2$ total, dimensionless freezing time; i.e., when center of casting freezes $U_a = (c/\lambda)(t_i - t_i)$ dimensionless interface temperature $U_{ai} = (c/\lambda)(t_i - t_i)$ dimensionless interface temperature at first instant of contact of melt with mold $U_b = (c/\lambda)(t_b - t_i)$ dimensionless pouring temperature $U_m = (c/\lambda)(t_i - t_m)$ dimensionless mold temperature initially $\beta = \sqrt{\frac{k\rho c}{(k\rho c)_m}}$ ratio of solid state properties of melt to mold properties $K = k/k_b$ ratio of solid state conductivity to liquid state conductivity**BIBLIOGRAPHY REFERENCES**

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WRITTEN DISCUSSION IS SOLICITED

NEW ALUMINUM-MAGNESIUM-ZINC CASTING ALLOY

By

H. C. Rutemiller*

ABSTRACT

A new heat treatable aluminum casting alloy designated as X250 has been developed for applications requiring good ductility, high tensile strength and excellent resistance to corrosion. This alloy contains 8 per cent magnesium, 1.5 per cent zinc, 0.25 per cent manganese, and 0.15 per cent copper. Casting characteristics and mechanical and physical properties are similar in general to those of the aluminum-10 per cent magnesium alloy, 220-T4, but alloy X250-T4 offers two important advantages—better resistance to stress-corrosion cracking and greater stability of tensile properties during natural aging.

INTRODUCTION

Widely varied physical and mechanical properties are available among aluminum sand casting alloys to fit the diversified requirements of engineering design. Where castings with high ductility and tensile strengths are specified, the binary aluminum-10 per cent magnesium alloy¹ designated as 220 is particularly well suited. In the solution heat treated and quenched condition, alloy 220 provides, in addition to superior mechanical properties, good machinability and excellent resistance to corrosion.

One feature of alloy 220-T4 that is an economic disadvantage is the need for a special quenching technique after solution heat treatment to provide an adequate resistance to stress-corrosion cracking. A quench in hot oil, or alternatively, a carefully timed interrupted boiled water quench is required². Furthermore, there is always the possibility of erroneous or accidental use of a too rapid quench in practice. A second characteristic of alloy 220-T4 that is susceptible to improvement is that its mechanical properties are altered slowly during natural aging. After very long aging periods, a significant decrease in ductility may occur.

This paper describes a new sand casting alloy, X250, which is the result of an investigation to develop an alloy that would retain the desirable mechanical

and physical properties of alloy 220-T4, and be better with regard to the two features mentioned above. The principal change in chemical composition from alloy 220 is the substitution of zinc for part of the magnesium content.

The nominal composition of the new alloy is: 8 per cent magnesium, 1.5 per cent zinc, 0.25 per cent manganese, and 0.15 per cent copper, with smaller amounts of titanium and boron for grain refinement, and beryllium for resistance to oxidation during melting and casting³. Comparative data on mechanical properties and resistance to stress-corrosion cracking are presented herein for alloys X250-T4 and 220-T4. The influence of some variations in chemical composition on the properties of alloy X250-T4 is shown, and physical properties of the alloy are given.

PROCEDURE

Tensile test bars cast to 0.505 in. diameter in green sand molds were used for evaluation. Melts were heated to 1370 F (743 C), then thoroughly fluxed with chlorine gas as they cooled to 1340 F (727 C), the pouring temperature. A two-step solution heat treatment is used for alloy X250, consisting of at least 8 hr heating at 825 F (440 C), followed by 8 hr at 925 F (496 C), and a full boiling water quench from 925 F. Castings with very thick sections may be cooled to 825 F before quenching, to reduce the possibility of quench cracking.

STRESS-CORROSION CHARACTERISTICS

The laboratory stress-corrosion test for aluminum casting alloys consists of loading a tensile test bar in a jig⁴ to an elastic deformation corresponding to a stress of about 75 per cent of the yield strength. The specimen is continuously exposed to a highly corrosive solution of 5.3 per cent sodium chloride plus 0.3 per cent hydrogen peroxide. If stress-corrosion cracking does not develop during 14 days, the material is judged to have an excellent resistance to stress-corrosion cracking. Failure of an alloy to pass this highly accelerated test does not mean that stress-corrosion will necessarily be a problem in service, but merely that additional service-type tests should be made.

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The resistance to stress-corrosion cracking of cast aluminum-magnesium alloys is invariably excellent immediately after solution heat treatment. It is only after a considerable period of natural aging, six months or even longer, that stress-corrosion cracking may become a problem. To avoid the delay which would be necessary before testing, a "sensitizing" treatment has been developed which brings out latent susceptibility. Samples heated at 212 F for 30 hr after quenching may be stress-corrosion tested immediately. This treatment was used for both alloy X250-T4 and alloy 220-T4 in the present work. Typical results from the 14-day accelerated test, using a stress level of 19,000 psi were:

Quench	Life in 14-day Test	
	220-T4	X250-T4
Full Boiling Water	1 day	No failures
Interrupted Boiling Water	No failures	No failures

Specimens of alloy X250-T4 given a full boiling water quench and aged for one year at room temperature, in lieu of the sensitizing treatment, also withstood the 14-day test without failure.

MECHANICAL PROPERTIES

Allowance for deviations from the nominal composition of alloy X250-T4 would be necessary during commercial production. The limits of 7.4–8.4 per cent magnesium and 1.2–1.7 per cent zinc were dictated primarily by the results of stress-corrosion tests. The tensile and yield strengths of alloy X250-T4 increase with increasing magnesium and zinc contents. The effect of variations within composition limits on tensile properties is illustrated in Fig. 1. Representative properties for alloy 220-T4 of nominal composition are included for comparison. Tensile properties of the two alloys are about equivalent, and the minimum specification of 42,000 psi tensile strength and 12.0 per cent elongation used for alloy 220-T4 are applicable to X250-T4.

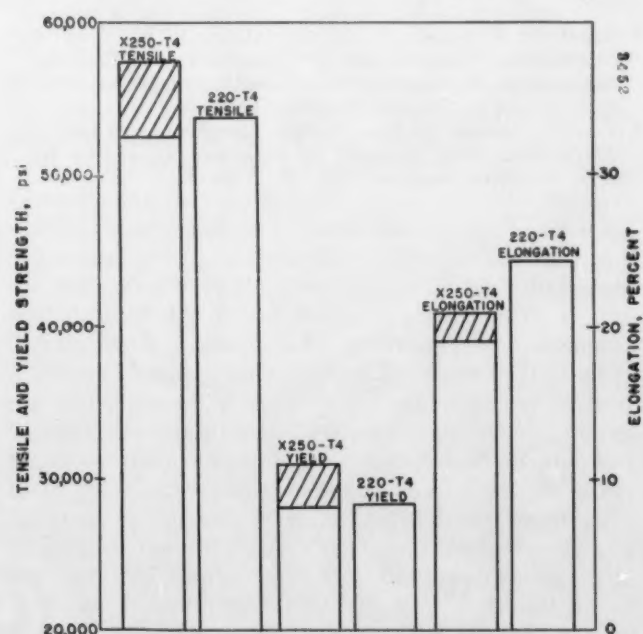


Fig. 1 — Effect on tensile properties of Mg and Zn variations within composition limits of alloy X250-T4 (crosshatched areas). Representative alloy 220-T4 properties also shown.

TABLE 1 — EFFECT OF COPPER AND MANGANESE ON THE PROPERTIES OF Al-8.0% MAGNESIUM-1.5% ZINC ALLOY

% Cu	% Mn	Tensile strength, psi	Yield strength, psi	Elongation, %	Life in 14-day stress corrosion test
0.01	0.01	52,700	25,800	24	10 days
0.15	0.01	54,100	28,500	20	No failures
0.36	0.01	49,400	29,100	14	2 days
0.15	0.26	56,400	29,500	19	No failures
0.16	0.50	59,200	32,200	13	10 days

The effect of copper and manganese on the tensile properties and resistance to stress-corrosion cracking of alloy X250-T4 is shown in Table 1. The addition of 0.15 per cent copper provides an important increase in resistance to stress-corrosion cracking and a slight improvement in tensile properties. A 0.25 per cent manganese addition is beneficial to tensile properties without affecting resistance to stress-corrosion cracking. Further increases in either copper or manganese are detrimental to both properties. Limits of 0.1–0.2 per cent copper and 0.2–0.3 per cent manganese have been adopted.

A summary of typical mechanical properties for alloy X250-T4 is presented in Table 2. Determinations were made 14 days after solution heat treatment.

Figure 2 shows the effect of one year of room temperature aging on the tensile properties of X250-T4 and 220-T4 alloys. While both alloys showed about a 20 per cent increase in yield strength after one

TABLE 2 — MECHANICAL PROPERTIES OF X250-T4 ALLOY

	Specified	
	Typical values	minimum values
Tensile strength, psi	55,000	42,000
Tensile yield strength, psi	28,000	
Elongation	18%	12%
Brinell hardness (500 kg, 10 mm)	90	
Compressive yield strength, psi	30,000	
Shear strength, psi	35,000	
Endurance limit (R. R. Moore type specimen; 500,000,000 cycles), psi	13,000	

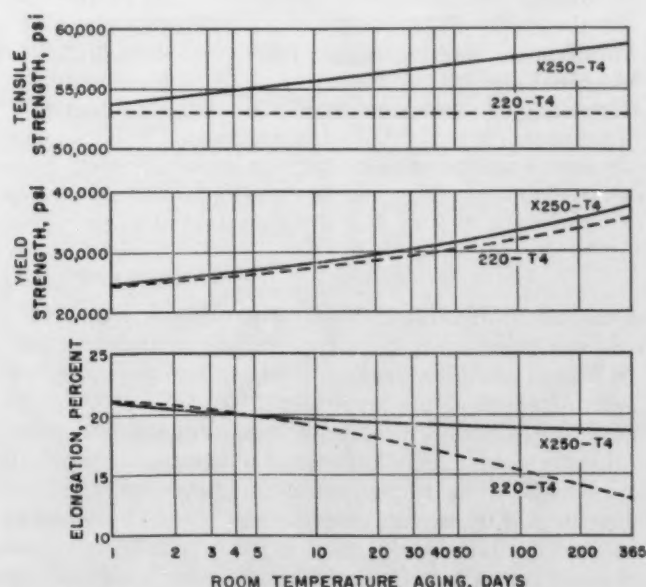


Fig. 2 — Effect of room temperature aging on tensile properties of 220-T4 and X250-T4 alloys.

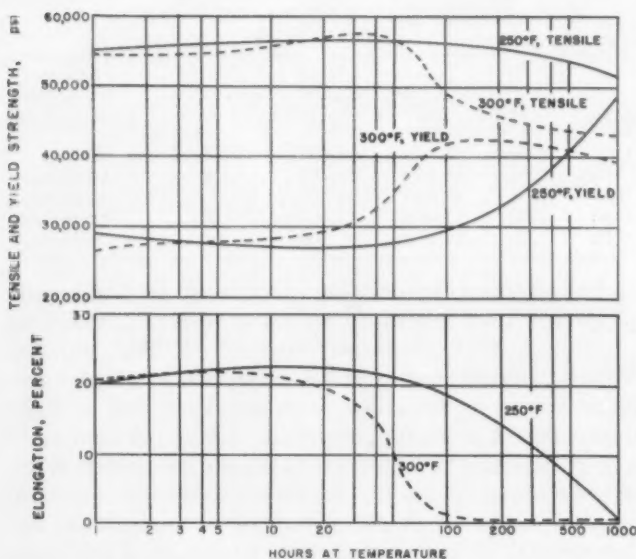


Fig. 3—Effect of elevated temperature aging on the room temperature tensile properties of X250-T4 alloy.

year, the ductility of X250-T4 remained relatively constant.

Alloy X250-T4, like 220-T4, should be used for applications where operating temperatures do not exceed 200 F (93 C). The effect of heating at elevated temperatures on tensile properties is shown in Fig. 3.

PHYSICAL PROPERTIES

Other characteristics of alloy X250-T4 are as follows:

Specific gravity	2.64
Weight, lb/cu in.	0.095
Electrical conductivity (per cent of International Annealed Copper Std.)	24
Thermal conductivity at 77F (25C) (C.G.S. units)	0.24
Average coefficient of thermal expansion, per degree F	
Range 68–212F	13.4×10^{-6}
Range 68–392F	14.1×10^{-6}
Range 68–572F	14.5×10^{-6}
Approximate melting range, F	850–1135
Machinability	Excellent
Resistance to corrosion	Excellent

CASTING CHARACTERISTICS

Sand castings of alloys X250-T4 and 220-T4 have been made and compared using commercial pattern equipment. The tensile properties of specimens cut from alloy X250-T4 castings were consistently higher than those cut from alloy 220-T4 castings, indicating that the new alloy has better feeding characteristics. However, the casting practices developed for aluminum-magnesium alloys, which include thorough chlorine fluxing and the use of extensive chilling and careful gating and risering practices⁵, will still be necessary to realize the inherent high properties of alloy X250-T4 in commercial castings.

APPLICATION

Alloy X250-T4 is particularly suitable for sand cast parts where good ductility, high tensile strength and excellent resistance to corrosion are desired, and where sustained operating temperatures do not exceed 200 F (93 C). The most attractive applications at present appear to be aircraft structural parts, frames and housings for marine applications; construction equipment subject to impact loads; and equipment for the dairy, food and chemical industries.

ACKNOWLEDGMENT

Some preliminary work which aided the development of alloy X250 was done by C. L. Goodwin, for which acknowledgment is hereby made.

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WRITTEN DISCUSSION IS SOLICITED

DUCTILE HIGH STRENGTH TITANIUM CASTINGS BY INDUCTION MELTING

By

J. Zotos,* P. J. Ahearn,* and H. M. Green*

ABSTRACT

Titanium alloy scrap was remelted by a modified induction melting technique and then processed into castings. Metallurgical evaluation of the castings included chemical analysis, macro and microstructure, and mechanical properties.

These tests indicate that scrap titanium can be reprocessed by induction melting and still exhibit desirable engineering characteristics that make it a useful foundry alloy.

INTRODUCTION

Melting and casting titanium and titanium-base alloys are difficult because of the metal's extreme reactivity with materials at elevated temperatures.¹ Even as early as 1939, Kroll discovered that molten titanium reacted violently with ordinary refractories such as silica, alumina, magnesia, and zirconia.² The melting process is complicated further because molten titanium rapidly dissolves oxygen and nitrogen; and their presence, even in small amounts, severely reduces the mechanical properties of the metal.³ Therefore, conventional melting and casting techniques require considerable modification for application to titanium.

The affinity of molten titanium for refractories has caused a lag in the development of suitable titanium casting processes in comparison with progress achieved in producing wrought titanium products. Metallurgical investigations over the past few years have indicated that production of cast titanium products on a commercial basis is a possibility in the very near future.

Titanium and titanium-base alloys are melted without atmospheric or refractory contamination in consumable-electrode and fixed-electrode, skull-melting furnaces under vacuum or a protective atmosphere of inert gas. The consumable-electrode furnace can either lip-pour or directly cast an ingot from progressive melting of the electrode, depending upon the desired product. Successful operation of the lip-pour type requires a rapid meltdown so that a minimum of titanium solidifies in the water-cooled copper crucible

before tapping the melt and limits the capacity of the melting equipment.

The direct-casting type produces ingots by melting and solidifying layer upon layer of titanium in a water-cooled copper mold. These ingots have surface imperfections and are heterogeneous to some extent. The tungsten or graphite-tipped fixed-electrode furnaces can be lip or bottom poured. Ingots and castings of limited sizes and shapes can be produced in either graphite or copper chill molds. In general, the operating technique required to produce titanium castings using the arc melting furnaces requires considerable skill on the part of the operator, for he must estimate when the optimum conditions for pouring exists. Also, it is difficult to get the desired amount of uniform superheat into the melts in the production of castings because of the detrimental effect of the superheat on the furnace skull.⁴

Titanium castings weighing up to 75 lb have been produced with a consumable-electrode, lip-pour, skull-melting arc furnace, using a water-cooled copper crucible.⁵ Several castings weighing from 2 to 50 lb have been made in fixed-electrode, lip and bottom-pour, skull-melting arc furnaces using graphite and water-cooled copper crucibles.^{6,7,8,9} Investigators have used these furnaces to cast titanium-silicon⁷ and titanium-aluminum-silicon⁸ alloys, and to evaluate a variety of mold materials.⁹

Carbon Contamination

Tilt and bottom-pour induction-melting furnaces with graphite or refractory linings have been used to melt titanium and produce castings weighing from 6 to 15 lb.^{10,11,12} This melting process yields homogeneous melts, and adequate superheat is attained for the manufacture of castings in water-cooled copper or graphite molds. When titanium is melted in a graphite-lined induction furnace, the carbon contamination ranges between 0.3 and 1.0 per cent,^{13,14,15,16} but the metal is considered unmachinable on a production basis if the carbon content exceeds 0.7 per cent.

Recently, the Rodman Laboratory experimented with a levitation skull-melting technique, using a tilt-

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pour, graphite-lined induction furnace to produce titanium ingots weighing from 20 to 25 lb with carbon contents of 0.13-0.22 per cent.¹⁷ This technique has been further developed to remelt titanium scrap to produce titanium ingots and castings weighing up to 35 lb with a maximum carbon content of 0.15 per cent.

The chemical reactivity of molten titanium with refractories limits the type of mold materials for producing smooth, sound titanium castings. Research conducted on shell molds of refractory oxides such as alumina, magnesia, silica, zircon, and zirconia showed that the oxides contaminated the titanium, with the thicker sections suffering the greatest.¹⁸ Various baked sand-mold mixes and investment mold materials were investigated for producing titanium castings, but the mold-metal reaction resulted in contamination of the product.^{19,20} Machined graphite, one of the first mold materials for casting titanium, is still used in spite of its high cost.

Edelman and Feild have overcome this economic disadvantage by developing an expendable graphite mold. This is composed essentially of a graphite powder that can be molded on wooden patterns with existing foundry equipment and techniques.²¹

The literature contains some data on the mechanical properties of heat treated titanium alloy castings at strength levels between 60,000 and 120,000 psi, but few researchers have investigated properties at higher strength. Structural applications for titanium castings will require a high strength-to-weight ratio. The objective of this investigation was to provide needed data by evaluating mechanical properties and the general metallurgical nature of cast titanium at the high strength levels.

PROCEDURE

The melting technique employed has previously been reported in detail.²² A coreless high-frequency induction furnace, mounted on trunnions inside an airtight chamber and powered by a 330 kva, 960 cycle motor generator, was used to melt the 6 per cent aluminum, 4 per cent vanadium, scrap titanium selected for this work. The 30 lb charge is placed in a graphite crucible; and the chamber is sealed and evacuated to a pressure of 500 microns. The electrical system employed does not operate under vacuum so an inert atmosphere of helium is introduced into the system to a slight positive pressure. After the power is turned on, the charge is melted and poured into a graphite mold in a 9 min. period. The rapid meltdown results from the high power input (300 kw) of the induction coil.

The major problem in induction melting titanium in a graphite crucible is the carbon contamination of the molten bath. This melting procedure minimizes contamination by reducing the area of contact between graphite crucible and molten titanium. As melting proceeds, the induction field pulls the molten titanium (Fig. 1) away from the walls of the crucible. Since a titanium skull is located in the base of crucible, the only point of contact between side-wall and the molten bath is at the top of the skull (Fig. 1). The small area of contact, coupled with a fast meltdown, produces 30-40 lb titanium ingots with a maximum carbon contamination of 0.15 per cent.

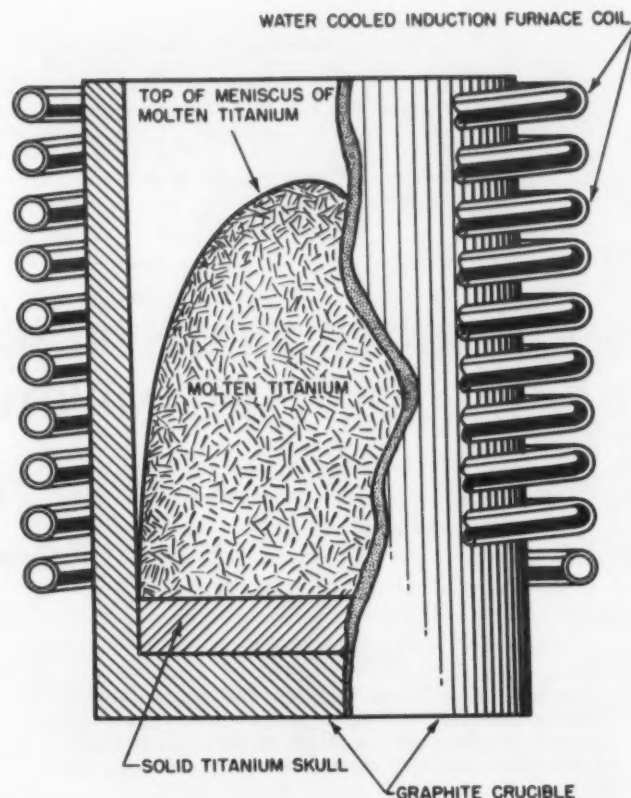


Fig. 1 - Titanium melting process.

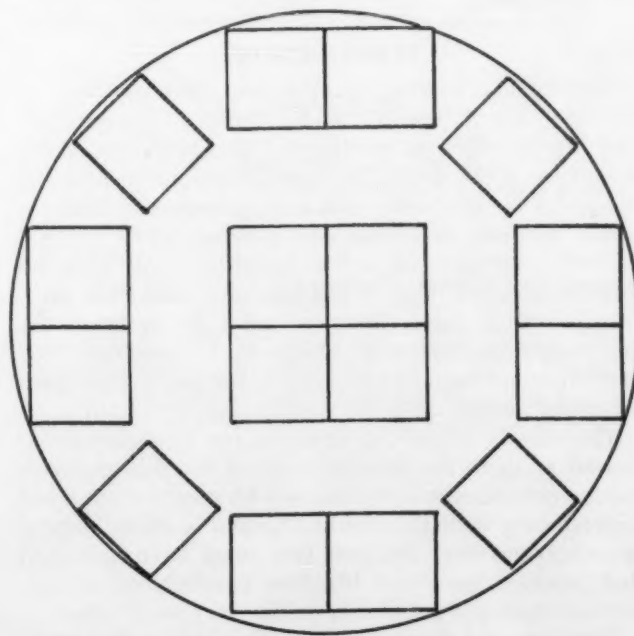


Fig. 2 - Location of test blanks.

The object of this investigation was to evaluate the metallurgical characteristics of the cast ingot resulting from this technique and to study the feasibility of pouring shape castings from the induction melted titanium. Study of the ingot material consisted of chemical analysis, macro and microscopic examination, and mechanical testing of heat treated blanks from the cast ingots. Accordingly, samples were removed from the ingots for analysis of alloying elements and contaminants such as carbon, oxygen and nitrogen. A

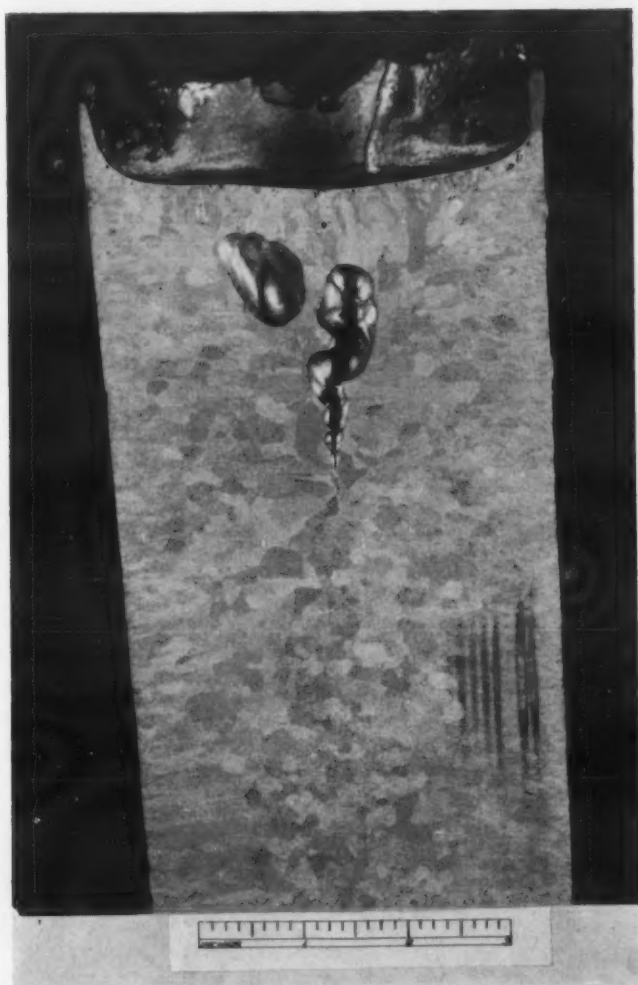


Fig. 3 — Macroetch of ingot section.

macro-test was conducted on a longitudinal surface through the center of an ingot. This surface was ground, etched in a solution of 10 per cent concentrated hydrofluoric acid and 90 per cent water for 5 min., and then examined to obtain information on the general macrostructure and shrinkage characteristics of the cast titanium.

Heat treatments were conducted on test blanks that had been removed from the ingot in accordance with the sketch of Fig. 2. The first treatment consisted of a solution anneal; the second was a solution and high-temperature age; while the third and fourth were selected as being representative of typical commercial hardening cycles in the treatment of 6 per cent aluminum, 4 per cent vanadium titanium alloy.

The actual heat treatment cycles were as follows:

Treatment No.	Solution	Age
1	1750 F, 1 hr — furnace cool	
2	1750 F, 1 hr — air cool	1200 F, 24 hr — air cool
3	1750 F, 1 hr — water quench	1050 F, 1-½ hr — air cool
4	1550 F, 1 hr — water quench	1000 F, 24 hr

Upon completion of the heat treatments, the blanks were machined into standard tensile (0.357 in.) and V-notch Charpy bars. Yield strengths were determined at 0.1 and 0.2 per cent offset, while the Charpy bars were broken at room temperature and -40 F. In addi-

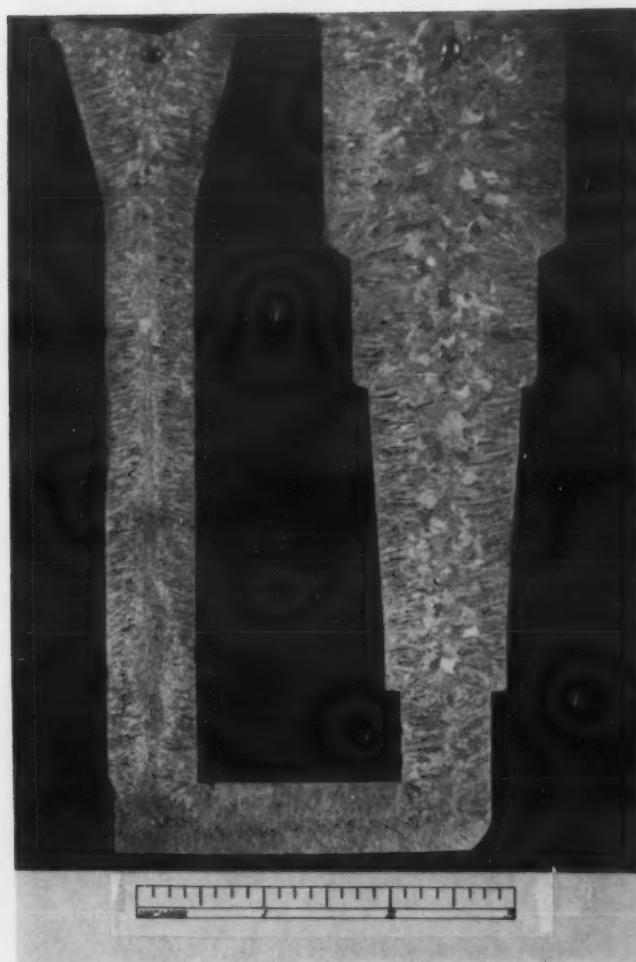


Fig. 4 — Macroetch of casting.

tion, metallographic examination of structures developed by the heat treatments were compared with the cast microstructure. This was done to assess the effectiveness of the solution treatments in dissolving the small amount of intermetallics present and to determine visually the effect of heat treatment on microstructure. All metallographic specimens were etched in a 1:1:3, HF:HNO₃:glycerine solution.

Interest was then directed toward the manufacture of a useful titanium casting. A suitable mold was machined from block graphite and then placed in the vacuum tank. A heat of titanium was melted in accordance with the outlined procedure and poured into this mold. After shakeout, the casting was blasted with aluminum-oxide grit and examined for cold shuts, definition and surface defects. A longitudinal surface through the center of the casting was then macroetched and examined in the same way as previously described for the ingot.

RESULTS AND DISCUSSION

The chemical analysis of the ingot that was heat treated and tested, the general range of analyses on similar ingots, and the average interstitial content of the scrap employed are given in Table 1.

The major problem in chemical control has been the increase in carbon content during the melting operation. This increase averages 0.12 per cent carbon and does lower ductility and impact resistance. The

TABLE 1 — ANALYSES OF SCRAP AND INGOTS

	Per cent by weight					
	V	Al	C	N	O	H
Ingot	4.05	6.28	0.15	0.028	0.170	0.0117
Chemical range of ingots	4.0-4.1	6.0-6.4	0.11-0.15	0.025-0.033	0.15-0.22	0.01 -0.015
Interstitial content of remelt scrap			0.01-0.03	0.01 -0.02	0.08-0.15	0.006-0.008

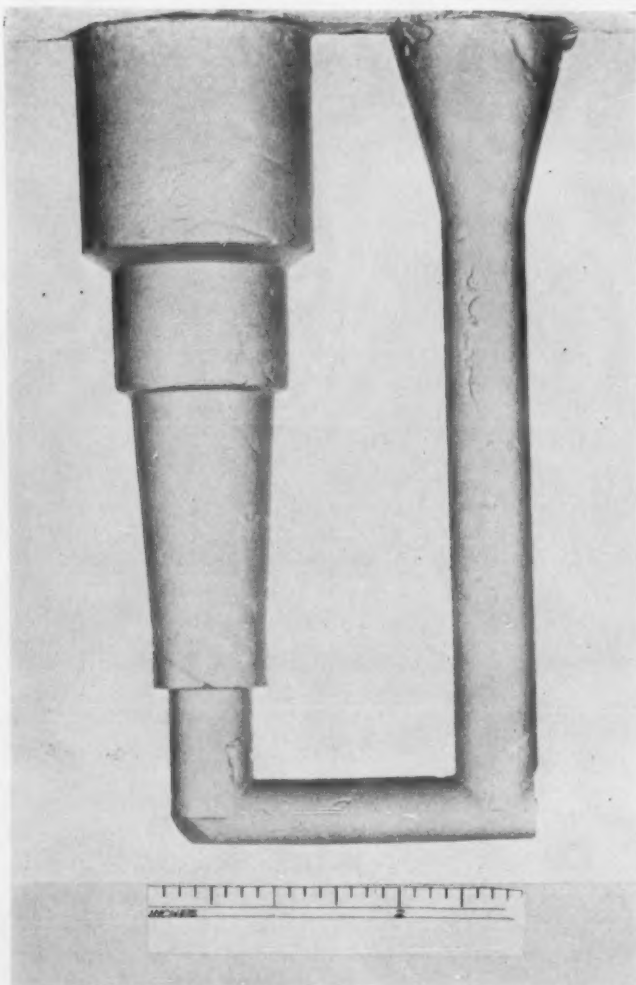


Fig. 5 — Surface of casting.

other interstitials, nitrogen, oxygen and hydrogen, do not increase to a harmful level although some thought has recently been given to the control of these elements, for they may contribute to harmful gas porosity in the castings.

The macroetch test information is presented in Fig. 3 and 4. The ingot section of Fig. 3 shows a marked columnar structure resulting from the chill effect of the graphite mold. Both the ingot and casting are sound with a moderate amount of solidification shrinkage at the top. Observed shrinkage seems to infer that riser volume required in casting of titanium is less than that for steel castings. There has been some experimentation with radiation shields above the riser surface to prevent capping over, but to date this has not been successful.

It will be noted that the macroetch surface at the top of the ingot (Fig. 3) does show a small area that may be associated with gas, while the macroetch of the casting (Fig. 4) does not exhibit this condition. Currently, every effort is being made to reduce hydrogen content by thoroughly drying all material going

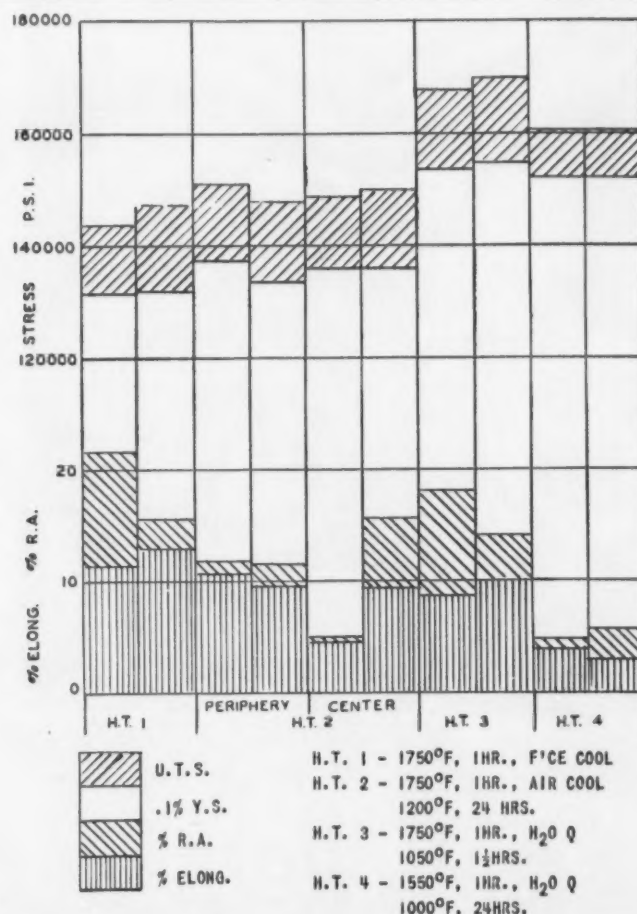


Fig. 6 — Mechanical properties.

into the melting chamber and preheating the molds.

Cast surfaces of ingot and casting were studied. Ingot have been poured with little or no superheat in order to minimize furnace time and solution of carbon by the heat. Thus the ingot had cold shuts and laps resulting from a low pouring temperature and the chill action of the graphite mold. This condition was partially alleviated in the casting (Fig. 5) by a small amount of superheat in the melt and by preheating the mold.

TABLE 2 — MECHANICAL PROPERTIES

Heat treatment	0.1% yield strength psi	0.2% yield strength psi	Ultimate tensile strength psi	Elong. %	Reduction of area %
1	131,500	133,000	143,750	11.4	21.6
	132,000	134,500	147,000	12.9	15.6
2	137,400	139,800	150,800	10.7	11.9
	133,800	135,800	147,400	9.3	11.4
Center*	136,000	139,000	148,600	4.3	4.9
	136,200	139,000	149,800	9.3	15.6
3	153,500	157,500	167,400	8.6	18.1
	155,000	159,000	169,400	10.0	14.0
4	152,200	155,800	160,600	3.6	4.4
	152,200	155,000	160,600	2.9	5.5

*All specimens taken from periphery, except where noted.

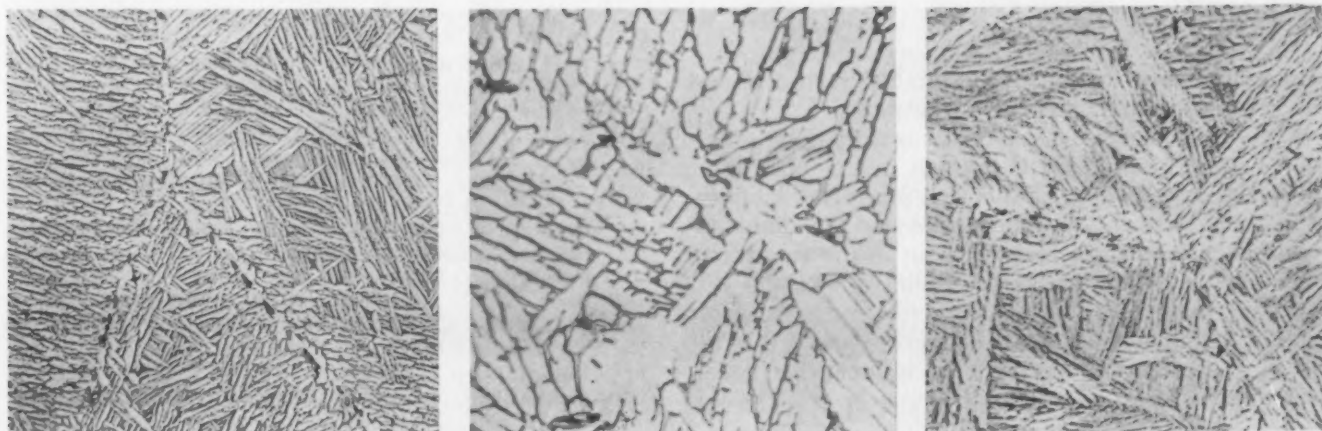


Fig. 7 — As-cast microstructures: left, ingot surface, $\times 250$; center, ingot surface, $\times 1000$; right, ingot center, $\times 250$.

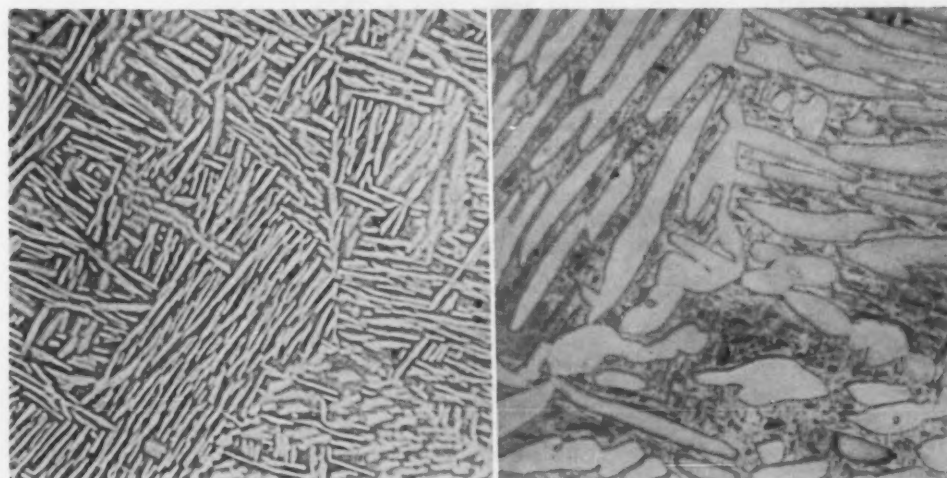


Fig. 8 — Typical microstructure after heat treatment: 1750 F for 1 hr, water quenched, 1050 F for 1-1/2 hr, air cooled. Left, $\times 250$. Right, $\times 1000$.

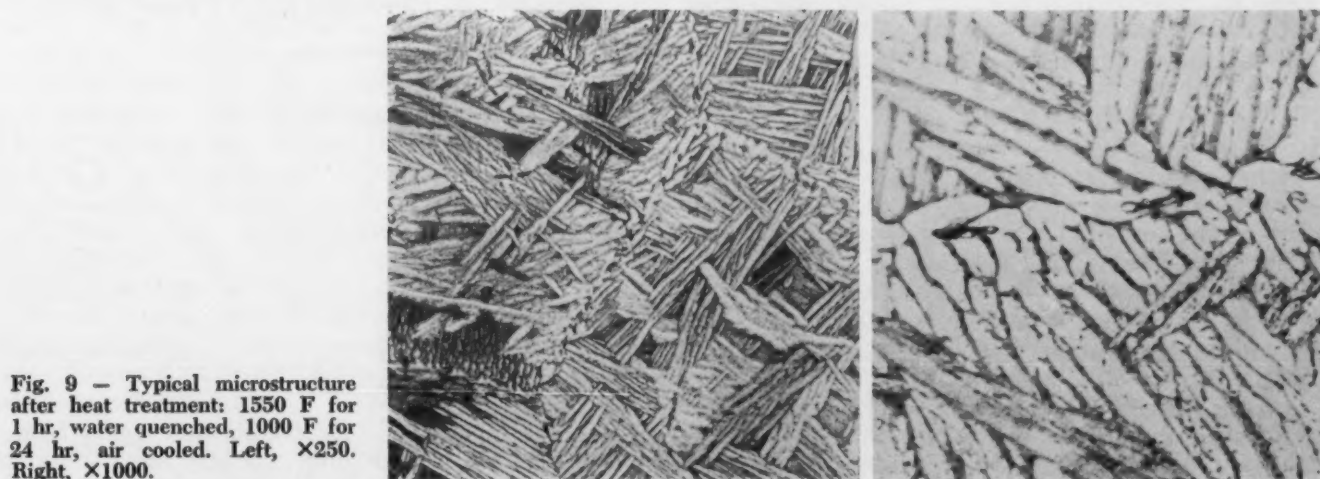


Fig. 9 — Typical microstructure after heat treatment: 1550 F for 1 hr, water quenched, 1000 F for 24 hr, air cooled. Left, $\times 250$. Right, $\times 1000$.

The mechanical properties, after the various heat treatments, are presented in Table 2 and Fig. 6. Microstructures, typical of the as-cast state and each heat treatment are shown in Fig. 7, 8 and 9 at $\times 250$ and $\times 1000$. Figure 7 illustrates the as-cast microstructure at the surface and center, respectively, of the ingot. These show the distribution of intermetallics in the boundaries and within the transformed beta grains. Figure 8 shows that after a solution treatment at 1750 F for 1 hr and a 1-1/2 hr age at 1050 F, the intermetallics have been completely dissolved. In fact, all treatments involving a 1750 F hold resulted in com-

plete solution of the intermetallics which were present in the as-cast condition; whereas, a typical hardening treatment, involving a quench from 1550 F and a 24-hr age at 1000 F (Fig. 9), still shows some grain boundary constituent.

The mechanical tests substantiated these observations, as the fracture surfaces of all tensile specimens given some type of treatment at 1750 F revealed little or no cleavage; whereas, the fracture surfaces of the tensile specimens given the 1550 F treatment showed cleavage along beta grain boundaries. As is to be expected, the ductility of material given the 1550 F

treatment was inferior to that of material treated at 1750 F. Thus, it is evident that either the lower solution temperature or smaller solubility in the alpha phase is responsible for the above results.

The optimum strength-ductility relationship is obtained with a 1-hr, 1750 F solution treatment, water-quenched and aged at 1050 F, 1-1/2 hr. The ductility of material given this treatment exceeded the minimum requirements set forth for extrusions in the transverse direction in Military Specification WA-PD-76C(1). However the Charpy impact strength, on the basis of a few preliminary tests, falls between 5 and 7 ft-lb at -40 F, indicating that the material is somewhat notch sensitive.

CONCLUSION

It has been shown that scrap titanium alloy can be remelted and made into castings with mechanical properties approaching the specification for forged titanium. The economic advantages of remelting scrap need not be discussed, but the method of melting appears to have significance in making castings. The induction stirring of the melting furnace produces metal of uniform composition and temperature.

Heretofore, such conditions have not existed in the casting of titanium. Further experimental effort is being directed toward reducing interstitial content, investigating mold materials and improving heat treatments.

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WRITTEN DISCUSSION IS SOLICITED

OCCURENCE AND ELIMINATION OF LEAKAGE IN A GUN METAL CASTING*

By

Marvin Glassenberg,** Alfred H. Hesse,*** and William H. Baer****

INTRODUCTION

The excellent corrosion resistance to sea water of gun metal or "G" bronze is widely known. However, the relatively wide region between the liquidus and solidus (mushy region) for this alloy has presented considerable difficulties to the foundryman in attempting to produce pressure-tight castings.

An investigation was conducted to determine factors which influence porosity in a particular gun metal casting and to find methods which would minimize this condition. A suction head casting weighing approximately 38 lb in the "as-cast" condition, Fig. 1, was selected for testing purposes. This particular casting was chosen because of its relatively high scrap rate in a production foundry. Using a ring-type gating system¹, porosity was studied in reference to gate and runner size, variations in the number of gates, blind risers, melt quality, pouring temperature, and chills. Studies were made by means of x-rays, pressure-tightness of the "as-cast" and "machined" casting, and macro and microexaminations.

This is a final report on the study of porosity in gun metal castings sponsored by the Navy Department, under Contract NOBS-62508, the prime contractor for which was Stemac, Inc. A progress report was presented before the annual 1955 AFS Convention in Houston, Texas, and later published in the 1955 AFS TRANSACTIONS, page 233.

PROCEDURE

Casting and Gating System

The suction head casting (Std. Navy Stock No. H11-WOR 14638) and ring-type gating system are shown in Fig. 1, 2. Originally, the system had eight equal



Fig. 1—Initial gating and runner system of suction head casting.

gates distributed equally along the periphery of the casting. The runner and gates had a trapezoidal cross-section. The cross-sectional area of the runner on either side of the sprue, between the sprue and first gate, was twice the cross-sectional area of the bottom of the sprue. The total area of the gates was slightly larger than the cross-sectional area of the runner between the sprue and first gate. To obtain a uniform distribution of flow through each gate, the cross-sectional area of the runner was reduced by the amount of cross-sectional area of the gate after each gate was passed. The runner and gates were designed to be completely filled with metal before feeding of the casting commenced.

As the program proceeded, the dimensions of the sprue, runner, and gates were altered to study their effect on casting soundness. The dimensions of the gating system used in each heat are listed in Table 1. The letters appearing in this table refer to the di-

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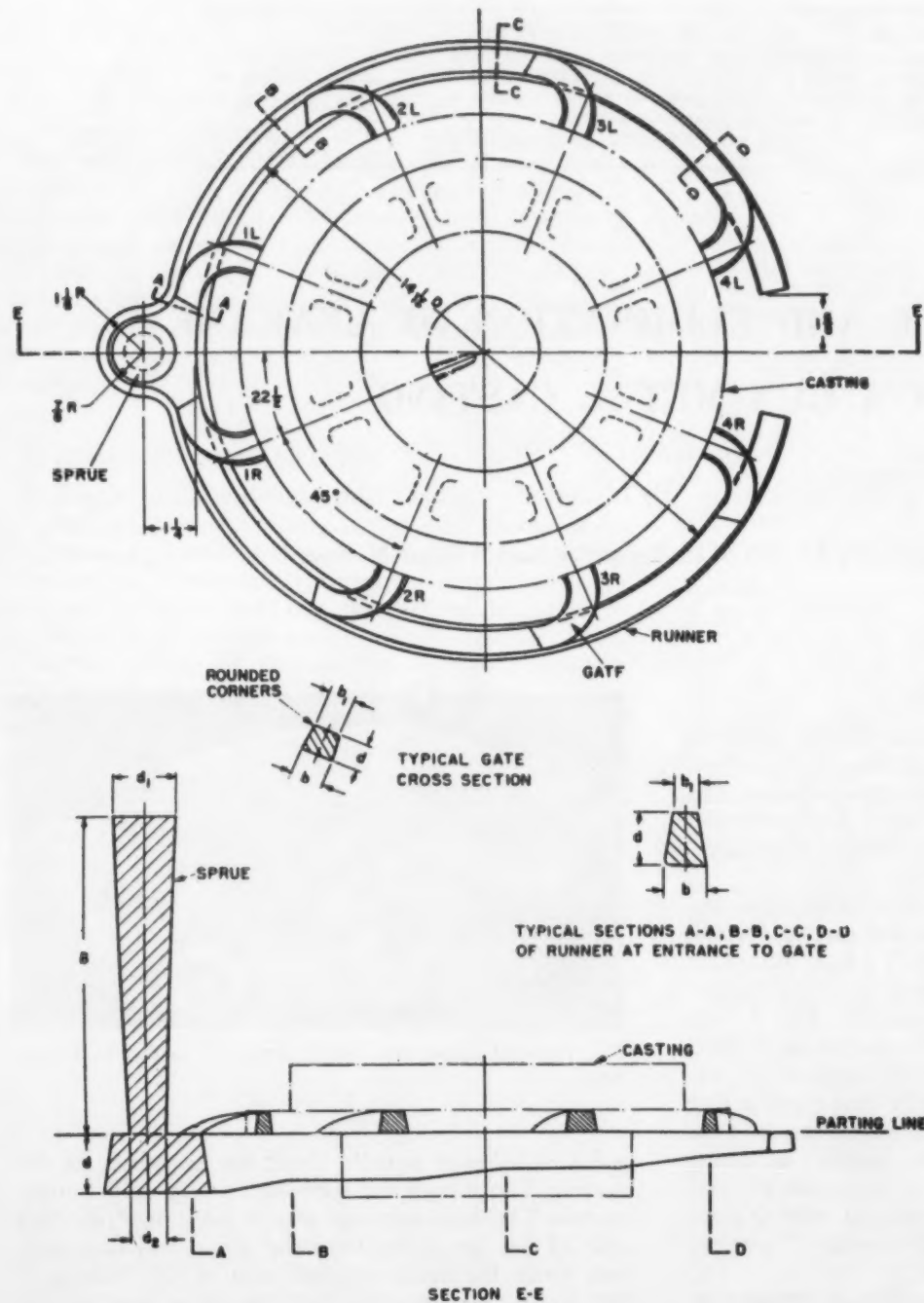


Fig. 2—Gating system for suction head casting.

mensions in Fig. 2. The sequence and reasons for making these changes are discussed under "RESULTS."

As noted in Fig. 2, the gates are numbered consecutively from 1R to 4R on the right side of the casting and 1L to 4L on the left side of the casting—the position of the sprue being the focal point. These numbers will also be referred to in the text to describe the relative position of the area on the casting. A general view of the mold and cores for casting the suction head is shown in Fig. 3.

Melting

Navy "G" ingots, containing a nominal composition of 88 per cent Cu, 8 per cent Sn, 4 per cent Zn; were melted in an oil-fired crucible furnace under a slightly oxidizing atmosphere. The zinc test was used to determine the atmosphere. Each heat of metal, melted

for casting the suction heads, contained about 210 lb. Two suction head castings were poured from each heat, designated as castings A and B. Casting A was always poured first unless otherwise noted. Approximately four ounces of phosphor-copper shot was added for deoxidation just prior to pouring. The composition was balanced to comply with military specification (MIL-M-16576) by the addition, prior to pouring, of approximately 1-1/2 to 2-1/2 lb of commercially pure zinc, depending on melt conditions and pouring temperatures.

The pouring temperature was taken with a chromel-alumel immersion tip thermocouple placed in the crucible prior to pouring. The temperature was indicated on a recording potentiometer. It required only several seconds to begin the pouring operation after the temperature was recorded.

Molding and Core Sand Mixtures

A sand mixture, consisting of about 50 per cent used and 50 per cent new No. 0 New Albany Sand, was used for making the molds at the beginning of the investigation. The moisture content and properties of the sand mixture are listed in Table 2. The moisture content of the sand was varied in an attempt to find its effect on porosity in the casting. The molds were rammed between a hardness range of 55-70.

Two cores were required for the suction head casting and can be seen in the foreground of Fig. 3. The composition of the cores was varied until a satisfactory mix was found. The final mix used was bank sand, 2 per cent cereal binder, 1/4 per cent iron oxide, 1-1/2 per cent core oil, and 3 per cent water. These percentages are based on the total weight of the mix.

After several heats, it was found that the small and large cores* had to be vented. The small core was vented with a hole through the center of the core and a hole molded in the green sand of the cope. The large core was vented by a cavity at the bottom of the core, as shown in the foreground of Fig. 3. The cavity also reduced the weight and made it easier to handle. The cavity is extended into a well made in the green sand located in the drag. The well is located 180 degrees from the sprue between the opposite ends of the runner and is aligned with a hole molded in the cope. In earlier heats, it was found that the sand between the well and each end of the runner washed away and caused all the venting passages for the large core to be filled with metal. To eliminate reoccurrence, a metal reinforcement was inserted at the end of the runner.

The small and large cores were baked at 425 F for approximately 50-60 min. A baked core sand pouring basin was placed above the sprue opening in order to obtain a constant head of metal and to eliminate entry of dirt and slag into the mold cavity. The sprue was kept full of metal during the entire pouring operation. The pouring basin is shown in the background of Fig. 3.

Pressure Testing

At the beginning of the project, the suction head castings were pressure-tested in the "as-cast" condition at 200 psi. The castings were subsequently machined and pressure-tested at 200 psi for a minimum of 15 min. It was found that the "as-cast" suction head, because of the tenacious, hard-cast skin, practically never leaked. Castings 9B and 10B, poured at 2035 F and 1940 F, were the only exceptions due to the low pouring temperature. Therefore, after casting No. 19, pressure-testing in the "as-cast" condition was eliminated and pressure-testing was conducted after the casting was machined.

DISCUSSION OF RESULTS

The castings from early heats exhibited metal penetration into the cores and gas blows, cracks between the ribs, and crushes. These defects were eliminated by: (1) using a satisfactory core mixture with proper

*The two cores for the suction head casting are referred to as small and large.

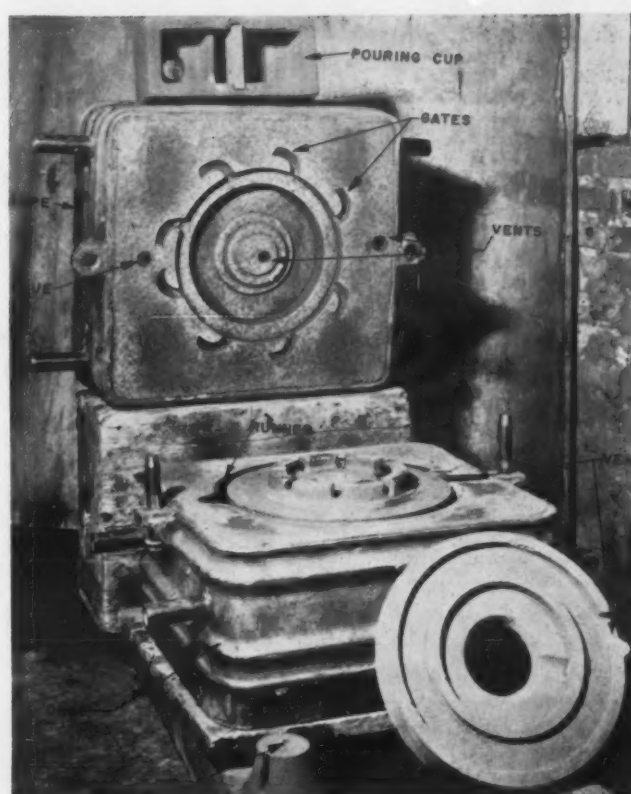


Fig. 3—Mold and cores for casting suction head.

venting of the cores, (2) reducing the pouring rate so that the total filling time for the mold was between 18-25 seconds, and (3) insuring good placement of the cores in the mold before assembling the cope on the drag.

In order to pour more slowly and maintain a full sprue, the size of the sprue was reduced starting with Heat No. 10. This resulted in Gating System 2 (see Table 1). A thorough study of the castings were made after Heat No. 9 since casting techniques and controls were believed to be satisfactory.

Equal Flow Through All Eight Gates

Radiographs of castings produced with the gating system having equal flow through all eight gates revealed mild to deep shrink cavities on the flange between gates 2L and 2R on the sprue side. The flange between 2L and 2R on the side opposite the sprue was relatively free of gross shrinkage. Most of the castings, poured between 1950 and 2165 F, leaked on the flange corresponding to defects disclosed by the x-rays.

Enlarging Gates 1L, 1R, 2L, and 2R

Gates 1L, 1R, 2L, and 2R were enlarged (Gating Systems 3 and 4), but most of the castings still leaked on the flange between 2L and 2R on the sprue side. Radiographs confirmed defects in this area and also on castings that did not leak. The radiographs also indicated that absence of defined shrink lines and presence of mottling did not necessarily indicate that the casting would not leak.

TABLE 1 — DIMENSIONS** OF SPRUE, RUNNER, AND GATES USED IN CASTING SUCTION-HEAD***

Heat No.	Gating System	Sprue		Runner				Gates			
		d ₁	d ₂	Section A-A	Section B-B	Section C-C	Section D-D	1L = 1R	2L = 2R	3L = 3R	4L = 4R
1-9	1	1½ area = 1.77 in. ²	¾ area = 0.60 in. ²	b ₁ = ⅝ b = 1½ d = 1.5 area = 1.31 in. ²	b ₁ = ⅝ b = 1½ d = 1.3 area = 1.10 in. ²	b ₁ = ⅝ b = 1 d = 1.12 area = 0.91 in. ²	b ₁ = ⅝ b = ⅞ d = 0.75 area = 0.56 in. ²	b ₁ = ⅞ b = 1½ d = 1½ area = 0.33 in. ²	b ₁ = ⅞ b = 1½ d = 1½ area = 0.33 in. ²	b ₁ = ⅞ b = 1½ d = 1½ area = 0.33 in. ²	b ₁ = ⅞ b = 1½ d = 1½ area = 0.33 in. ²
10-12	2	1⅝ area = 1.35 in. ²	¾ area = 0.44 in. ²	"	"	"	"	"	"	"	"
13	3	"	"	"	"	"	"	b ₁ = 1⅞ b = 1½ d = ⅝ area = 0.58 in. ²	b ₁ = 1⅞ b = 1½ d = ⅝ area = 0.58 in. ²	"	"
14-16	4	"	"	b ₁ = ¾ b = 1¼ d = 1.5 area = 1.50 in. ²	b ₁ = ¾ b = 1¼ d = 1.12 area = 1.05 in. ²	b ₁ = ¾ b = 1 d = 0.75 area = 0.65 in. ²	b ₁ = ¾ b = ⅞ d = 0.375 area = 0.31 in. ²	b ₁ = ¾ b = 1⅝ d = ⅞ area = 0.47 in. ²	b ₁ = ¾ b = 1⅝ d = ⅞ area = 0.47 in. ²	"	"
17, 18, 19	5	"	"	"	"	"	"	Eliminated	b ₁ = ⅞ b = 1½ d = ⅝ area = 0.61 in. ²	"	"
20, 21	6	1⅝ area = 1.35 ²	¾ area = 0.44 ²	b ₁ = ¾ b = 1½ d = 1.5 area = 1.50 in. ²	b ₁ = ¾ b = 1¼ d = 1.12 area = 1.05 in. ²	b ₁ = ¾ b = 1 d = 0.75 area = 0.65 in. ²	b ₁ = ¾ b = ⅞ d = 0.375 area = 0.31 in. ²	b ₁ = 1⅞ b = 1½ d = ⅞ area = 0.8 in. ² Blind Riser	b ₁ = ⅞ b = 1¼ d = 1½ area = 0.33 in. ²	b ₁ = ⅞ b = 1¼ d = 1½ area = 0.33 in. ²	b ₁ = ⅞ b = 1¼ d = 1½ area = 0.33 in. ²
22, 23, 31, 32	7	"	"	"	"	"	"	"	gate opened up approx. 4½ in. width area = 2.8 in. ² Blind Riser	"	"
24-28 29° 30° 35 36-39 40°-47°	8	"	"	"	"	"	"	"	b ₁ = ¾ b = 1⅞ d = ⅞ area = 0.56 in. ²	"	"
33, 34	9	"	"	"	"	b ₁ = ¾ b = 1½ d = 1.12 area = 1.05 in. ²	b ₁ = ¾ b = 1½ d = 1.12 area = 1.05 in. ²	"	b ₁ = ⅞ b = 1¼ d = 1½ area = 0.33 in. ²	"	b ₁ = ¾ b = 1¼ d = ⅞ area = 0.56 in. ²

*Metal chill used in mold.

**All dimensions in in.

***Refer to Fig. 2.

Gates 1L and 1R Removed

When gates 1L and 1R were removed (Gating System 5), the defects on the flange at 1L and 1R were eliminated, as shown by x-rays, but shrinkage still remained in regions 2L and 2R with a tendency towards 3L and 3R, respectively. Gates 1L and 1R were not used thereafter.

Blind Risers

Blind risers were subsequently studied by placing them on gates 2L and 2R (Gating System 6) to determine if feeding could be effected in the defective area. The two castings poured in Heat No. 20 leaked profusely all over the flange. One of the castings produced in Heat No. 21 did not leak; however, x-rays showed that the defects were still confined to areas 2L and 2R, indicating that the blind riser did not

feed to any noticeable distance. The inferior results obtained in Heat No. 20 as compared to Heat No. 21 were further investigated and found to be most probably due to melt quality. Blind risers were again tried on two more heats except that the gates leading from the blind risers were opened to improve feeding. The results indicated an improved area in 2L and 2R, but defective areas in other parts of the flange. Also noted was that the amount of leakage decreased with increasing pouring temperature. The castings were poured from 2080-2145 F.

High Pouring Temperatures

Additional heats were conducted, with and without blind risers, to investigate the merits, if any, of high pouring temperature. The results of two heats using high pouring temperatures (2200-2270 F) with blind

TABLE 2 — PROPERTIES OF NO. 0 NEW-ALBANY SAND USED IN EACH HEAT

Heat No.	Moisture, %	Green Compression	Green Permeability	Dry Shear, psi	Flowability
2	7.9	7.7	..	22	..
3	7.4	7.5	15	16.5	..
4	7.7	7.2	14	16	..
5	6.5	7.6	17	14	..
6	6.2	8.8	18	10.5	68
7	6.6	8.1	14	12	71
8	7.4	6.7	15	18	72
9	6.8	7.4	16	16	70
10	6.5	7.0	15	12.5	72
11	6.5	6.8	17	15	69.5
12	8.2	5.8	15	23.5	73
13	8.0	5.8	15	22.5	73
14	8.5	5.2	16	24.5	74
15	6.1	6.8	16.7	15.5	72
16	6.8	5.8	16.6	18	71.5
1C	6.8	5.8	18.4	16.5	72.5
17	6.3	6.3	17.8	18	74.5
18	8.9	4.8	..	22.5	77.5
19, 2C	6.5	6.2	..	17.5	75
20, 21	6.8	5.9	16.2	16	73.5
22, 23	6.1	6.4	15.7	15	75
24, 25	6.5	5.6	16.2	17	75
27, 28	7.3	5.2	16.7	19.5	74
29, 30	7.1	5.5	17.8	21	75
31, 32	6.4	6.1	18.4	14	75
33, 34	6.9	5.7	17.3	20	77
36	8.5	5.8	12.2	..	..
37	7.7	6.7	14.3	..	..
38, 39	7.0	8.3	16.2	..	..
40	6.5	..	..	..	..
41, 42	6.0	6.6	11.0	..	..
44, 45	6.5	..	..	..	..
46, 47	6.4	..	..	..	..

risers indicated that the risers did not eliminate shrinkage beyond gates 2L and 2R. Leakage and shrinkage was prone at 1L-1R, 3L-3R, and 4L-4R.

Without blind risers, the results of high pouring temperatures were sporadic. The four castings from Heat No. 27 and 28, poured between 2260 and 2280 F, did not leak while most of the castings from Heat No. 24, 25, 36, 37, 38 and 39, poured between 2200 and 2270 F, leaked under pressure. The "as-cast" tensile bars from Heat No. 24, 25, 27 and 28 indicated excellent melt quality, Table 3.

Although radiographs revealed a small amount of shrinkage between 2L and 3L and between 2R and 3R for the castings produced in Heat No. 27 and 28,

TABLE 3 — TENSILE PROPERTIES OF AS-CAST TEST BARS CAST IN NEW ALBANY SAND FOR VARIOUS HEATS

Heat No.	No. of bars tested	Tensile strength, (psi)	Elongation, (%)
24	2	54,500	54
25	2	54,500	55
27	4	53,400	55.5
28	2	53,100	55
29	2	54,900	60.5
30	2	52,500	63
31	2	52,200	66
32	2	48,000	42
33	2	49,500	51
34	2	50,000	60.5
35	2	51,000	56.5
40	2	51,000	42
41	2	50,800	36.0
42	2	50,300	51
43	4	53,300	41
44	2	52,300	44
45	2	50,500	52
46	4	56,400	59
47	3	54,000	57.5

these castings were definitely superior to those cast in Heat No. 24, 25, and 36-39. By chance, the non-leakers may have contained the same amount of porosity as the other castings but did not contain continuous passage for leakage to occur. Nevertheless, the overall results indicated that removal of gates 1L and 1R and high pouring temperatures seemed to displace the shrinkage that existed before between gates 1 and 2 towards gates 2 and 3, on both sides of the casting.

Gates Interchanged

In Gating System 3, the gates on the pattern were interchanged so that the larger gates were placed farthest from the sprue and the smallest gates closest to the sprue. This was made in an attempt to increase flow of metal into the cavity from the gates located farthest from the sprue. The increased flow was intended to compensate for the hotter metal entering the cavity from the gates closest to the sprue. The results were very poor, leakage being present on all of the castings, including the regions 3L, 3R, 4L, and 4R, which hardly ever leaked before this type of gating system was tried.

Sand and Microstructure

Generally, the New Albany No. 0 sand had an average moisture content between 6 and 7 per cent (Table 2). However, the sand contained a higher moisture content in some of the heats: 8.2, 8.0, 8.5, and 8.9 per cent in Heat No. 12, 13, 14, and 18, respectively. Castings from Heat No. 12, 13, and 18, when compared to castings produced with the same gating system, did not show any evidence that the high moisture content enlarged or increased the defects in the casting. However, the castings from Heat No. 14 appeared to contain a larger number of defects than other castings with the same gating system (Heat No. 15 and 16).

In an attempt to study the macrofracture of the castings, parts of the flange were broken off from the castings and examined. One observation of the macrofractures was the appearance of a shiny metallic phase that was either finely dispersed or in the form of large globules. This phase was identified as a tin-rich compound that was rejected from solution during the last stages of solidification. It is conceivable that the phase would be finely dispersed if cooled rapidly and in the form of globules when cooled slowly. Initial observations seem to indicate that globules of this phase were present in regions of intense porosity and finely dispersed in regions that did not leak.

A section of the flange was submerged in a 50 per cent HCl solution, and bubbles of hydrogen evolved from the tin-enriched phase. This further identified the phase, since tin is the only possible element in the alloy that will react in this manner with HCl.

Coupons were cut out of the flange of Casting No. 13B for metallographic examination. The coupons were taken from regions 1R (leaking area) and between 4L-4R. Macroexamination of the polished coupons indicated severe dendritic shrinkage in coupon 1R-1L and moderate shrinkage in coupon 4L and 4R.

Chills

The use of chills was first investigated in Heat No. 29 and 30. A gun metal chill coated with a graphite wash was placed in the large core corresponding to the flange between 2L and 2R on the sprue side. The location of the chill in reference to the casting is shown in Fig. 4A. The chill was placed in the core in the green state and baked with the core. The wash was applied to the chill after the core was baked and cooled to room temperature. As with all cores, it was placed in a heated oven prior to inserting it into the mold to drive off surface moisture. The chill tapered from a minimum thickness of 3/8-in. between Gates 1L and 1R, to a maximum thickness of 5/8-in. at 2L or 2R. The base dimension measuring 1 in. was exposed to the cavity.

The results from Heat No. 29 and 30 indicated the flange between 2L and 2R on the sprue side to be sound. However, shrink and leakage was prone at 3L and 3R with some slight shrink at 2L or 2R corresponding to the end of the chill. Casting No. 29A, poured at 2260 F, seemed to be of better over-all quality when compared to the castings from Heat No. 27 and 28 poured at 2260 to 2280 F without using chills.

Chills were again used in Heat No. 40-47. However, the size of the chill and the thickness were modified from those used in Heat No. 29 and 30. As shown in Fig. 4B, the chill was made in a complete circle instead of a semi-circle used in Heat No. 29 and 30. The chill was tapered from minimum thickness of 11/32-in. at regions 2L-3L and 2R-3R to a minimum of 19/32-in. at regions 1L-1R and 4L-4R. The width at the top and bottom was 1-3/16 in. and 1-3/8 in. In Heat No. 40-44 the base measuring 1-3/16 in. was exposed to the cavity. In Heat No. 45-47 the base measuring 1-3/8 in. was exposed to the cavity.

In either case, the base exposed to the cavity was machined and coated with a graphite wash. The results from previous castings and thermocouples placed in the mold cavity indicated the metal entering 2R and 2L to be the hottest as compared to the metal entering 4L and 4R or that collecting in regions 1L-1R. The chill was intended to make the metal in the flange solidify directionally from regions 1L-1R and 4L-4R to regions 2L-3L and 2R-3R.

In Heat No. 40-42, the chill was placed in the large core. The chill was placed in the core in the green state, baked, and subsequently coated with graphite. Practically all of the castings made from these heats had some washing occurring in the region adjacent to gates 2L and 2R. Since the hottest metal entered these gates, the defect may have been caused by the hot metal being exposed to a relatively cold chill, causing a minor explosion and rapid deterioration of the sand in the adjacent area. After the explosion, the sand may have dropped from the cope and washed into the cavity by the onrushing metal.

Also noticeable was that the first casting poured in each heat suffered more intense washing than the second casting produced from the same heat. The first casting poured corresponded to the first mold completed and was assembled about three-quarters of an hour before the second mold was completed and assembled. The pouring operation usually was done approximate-

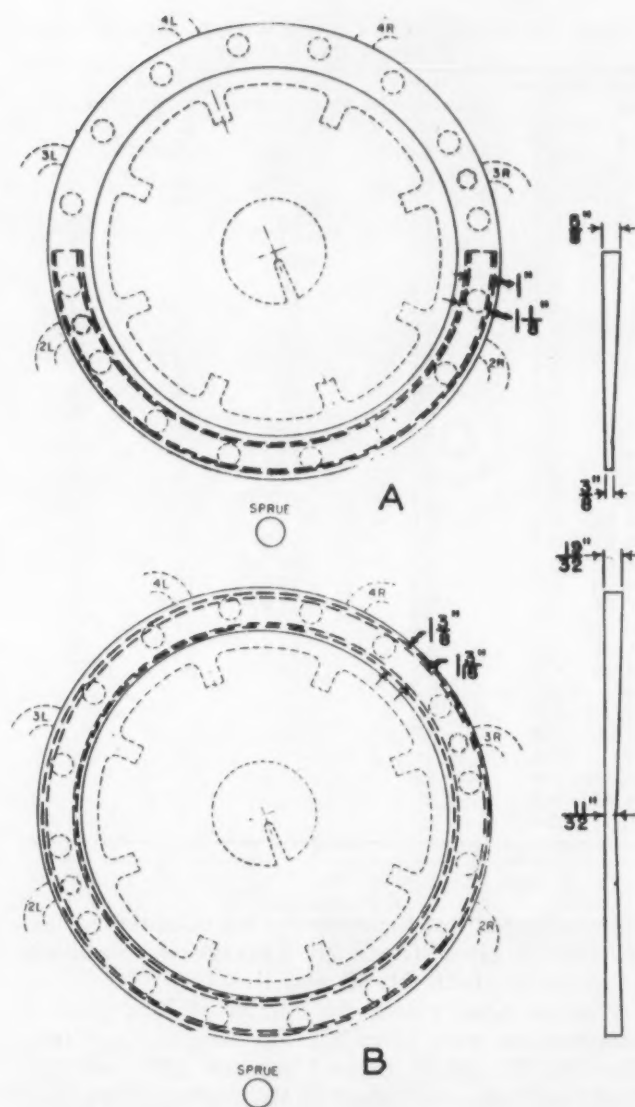


Fig. 4—Location of chill in (A), Heat No. 29-30; and (B), Heat No. 40-47.

ly 15-45 min after the second mold was assembled. It is conceivable that moisture in the molding sand could condense on the relatively cold metal chill prior to pouring. Since the length of time the chill is exposed to the mold would be proportional to moisture pickup by the chill, the first mold would be expected to contain more sand washing.

In Heat No. 43, the chill was placed in the cope with the base measuring 1-3/16 in. exposed to the cavity. The metal therefore had to reach the level of the top of the flange before it was exposed to the chill. Molding the chill in the cope was difficult.

Castings 41B, 42B and 43B, poured at 2105, 2125 and 2100 F, were machined and did not leak. Unfortunately, the other castings in this lot had to be discarded due to intense sand washing. The x-rays of castings 41B and 42B indicated the flange to be sound and free of any shrinkage. The x-ray of casting 43B indicated a small amount of shrinkage at 2L and 2R. It is possible that when the chill is molded in the cope, at a critical time, the metal shrinks away from the chill as it solidifies and results in poor heat transfer from the casting to the chill.

The above results indicated that the use of chills produced a sound flange and non-leakers. The subsequent castings were made to verify the results and obtain the pouring range required to obtain sound castings.

The chill was slightly modified for casting No. 45-47 in that the base dimension of 1-3/8 in. was exposed to the cavity. It was therefore possible to draw the chill out of the core after it was baked. Prior to assembling the mold, the core was heated to drive off surface moisture, cooled to a temperature for handling, and placed in the mold. The chill was maintained above 212 F and placed in the core just prior to assembling the cope on the drag. In addition, the molds were closed just prior to pouring to prevent the chill from picking up moisture from the molding sand. This practice eliminated sand washing that occurred in casting No. 40-43. Castings from Heat No. 44-47, poured between 2090 and 2180 F, were machined and did not leak. X-rays disclosed a sound flange.

Coupons were cut out of casting 47B and compared to corresponding coupons cut from casting 4A. Except for the coupon cut out of region 4L, the former casting had a much denser structure and was free of gross microporosity. Porosity existed in region 4L of casting 47B, but sufficient material surrounded the defect to make it harmless as far as leakage was concerned.

CONCLUSION

After the ring-type gating system on the suction heat casting was used, a number of observations were made:

- 1) Employing a runner system in the drag that was progressively throttled down in cross-sectional area to obtain a uniform flow distribution through each gate, castings were produced that did not leak in any part of the machined casting except the outer flange. Good directional solidification occurred on the flange fed from the gates located farthest from the sprue. Regions extending from 2L and 2R on the sprue side exhibited prolific shrink areas. As expected, thermocouples placed in the mold indicated the metal to be coldest in the region of 4L and 4R and to increase in temperature as it approached regions 3L-3R, 2L-2R, and 1L-1R. Although uniform flow

through each gate is theoretically sound and can be applied to simple shapes, difficulty can arise when equal amounts of metal at different temperatures enter the mold and cause poor directional solidification.

- 2) Enlarging gates 1L-1R and 2L-2R in an attempt to increase the flow of hotter metal into this region did not greatly improve this region of the casting.
 - 3) Eliminating gates 1L and 1R improved the metal structure in this region of the flange; however, porosity was still prevalent and intense on the flange adjacent to gates 2L and 2R.
 - 4) Feeding metal into regions 2L and 2R by means of a blind riser did not improve the flange in this area. The system also seemed to have caused a poor structure on the flange in the area of 1R and 1L, even though gates 1L and 1R were eliminated in this gating system. Widening the gate from the blind riser (2L and 2R) improved the structure on the flange adjacent to the riser, but did not extend much beyond this region.
 - 5) The results of high pouring temperature were sporadic. In some cases high pouring temperature produced non-leakers and in other cases, leakers were prevalent.
 - 6) No definite correlation between x-ray analysis and leakage could be found. Large shrink cracks shown by the x-ray film usually indicated a leaky casting, but a mottled or hazed appearance on the film gave no indication whether the casting would leak or not.
 - 7) Use of a full, round gun metal chill coated with a graphite wash and placed in the core corresponding to the flange resulted in a sound flange and pressure-tight casting. Ten pressure-tight castings from seven separate heats were obtained by use of chills. Not a single machined casting that used a chill was found to leak. X-rays of the flange of the castings using a chill in the core were found free of porosity.
- It is believed that the suction head casting can be produced economically and with a very low percentage of leakers by the method of chills coupled with a ring-type gating system as used in Heat No. 40-42 and 44-47.

REFERENCES

1. Grube, K. and Eastwood, L. W., AFS TRANSACTIONS, v 58 (1950).

This paper has been approved for presentation at the 62d Annual Meeting of the American Foundrymen's Society, to be held in Cleveland, May 19-23, 1958. The Society reserves all rights for publication either prior to or subsequent to presentation, and is not responsible for statements or opinions advanced herein.

WRITTEN DISCUSSION IS SOLICITED

FOUNDRY PRACTICE FOR SAND CASTING COMMERCIALLY PURE ALUMINUM

By

Robert V. Scalco* and Moss V. Davis**

ABSTRACT

This paper describes the foundry practice for sand casting commercially pure aluminum. A comparison is made of the foundry practice employed in sand casting the usual aluminum foundry alloys and the modifications necessary to produce castings of commercially pure aluminum. The difficulties arising from ease of gas adsorption, high solidification shrinkage, and low mechanical properties are discussed. Mechanical and electrical properties of commercially pure aluminum castings are presented.

The low mechanical properties of commercially pure aluminum sand castings usually eliminate this metal from the engineer's and designer's consideration. If the electrical property is the major requirement of a casting, commercially pure aluminum castings are used because of their high electrical conductivity, 55 per cent I.A.C.S. (International Annealed Copper Standard) or greater.

Since there is little information available on the foundry practice of sand casting pure aluminum this paper was written to present one foundry's methods for producing pure aluminum castings.

APPLICATION OF ALUMINUM CASTINGS

Pure aluminum castings are used in electric power connectors, rotors for aircraft and missile applications and other applications requiring aluminum of the highest conductivity.

Anderson Electric Corp. sand casts a variety of electrical connectors from commercially pure aluminum. Figure 1 illustrates some of these castings which vary in weight from 0.02-2.8 lb.

FACTORS INFLUENCING FOUNDRY PRACTICE

The foundry practice employed in casting commercially pure aluminum in green-sand molds is determined by the inherent characteristics of this metal. The following factors must be considered when sand casting pure aluminum:

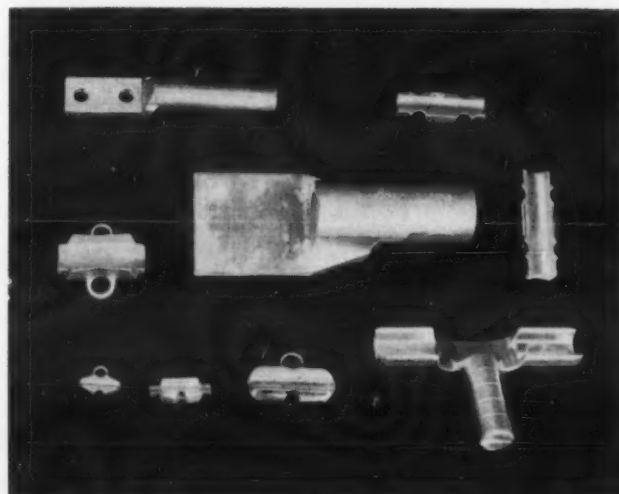


Fig. 1 - Typical pure aluminum castings for electric power connections.

- 1) The solidification range of 25 F (14 C) and solidification shrinkage of 6.6 per cent makes feeding extremely difficult.
- 2) The tendency of this metal to be "hot short" requires close attention to casting design and core practice, where cores are used.
- 3) The ease of hydrogen adsorption on the surface of molten metal requires close attention to the melting practice employed.
- 4) Low mechanical strength necessitates extremely careful shakeout procedures and subsequent handling of the castings to avoid deformation of the castings.
- 5) The soft aluminum castings cause galling or seizing, as well as loading of saws and abrasives used in cutting gates and risers.

The above factors dictate a modification in the foundry practice used with aluminum alloy castings. These deviations from the usual foundry practice will now be discussed in detail.

*Foundry Metallurgist and **Chief Metallurgist, Anderson Electric Corp., Birmingham, Ala.

MELTING AND POURING PRACTICE

Metal Charge

The metal charge is composed of virgin commercially pure aluminum pig or ingot and foundry returns from pure aluminum castings. The charge usually consists of 50 per cent pig or ingot and 50 per cent foundry returns. Since Aug. 1, 1957 commercially pure aluminum ingot and pig from primary producers has a minimum aluminum content of 99.50 per cent. The analysis for ingot used in connection with this paper is shown in Table 1.

TABLE 1 — CHEMICAL COMPOSITION OF TYPICAL COMMERCIAL PURE ALUMINUM INGOT

Al	Cu	Fe	Element, %		Ti	V	Ga
			Si	Cr			
99.70	—	0.16	0.09	0.02	—	0.01	0.02

Melting Practice

The metal is melted in gas-fired crucible furnaces having a capacity of 400 lb. The usual charge is 300 lb of metal. Since hydrogen is more readily absorbed by molten commercially pure aluminum than in the aluminum casting alloys all the usual precautions must be taken to avoid and prevent gas adsorption during melting. After melting, metal in the furnace ranges from 1350–1450 F (732–788 C).

Excessive temperatures must be avoided to prevent the aggravation of the gas adsorption problem.

Fluxing of Melt

A proprietary flux is used in melting pure aluminum. An amount of 8 oz per 100 lb of metal melted is considered sufficient. Half of this amount is added to the "heel" of metal during the first stages of charging and the remainder is added after nitrogen fluxing the molten metal.

Removal of the absorbed gases is accomplished by a period of fluxing with dry nitrogen gas. The fluxing with nitrogen continues until a sample of the metal is found to be gas free when solidified under vacuum.

Pouring Practice

After the melt is found to be gas free it should settle for a minimum of 5 min and a maximum of 15 min. The furnace should then be emptied as rapidly as possible into preheated, dry ladles to obtain the best results. Refractory ladles should be used to prevent any iron pick-up.

The ladle temperature of pure aluminum melt should not exceed 1400 F (760 C). The usual pouring temperature is between 1350–1400 F (732–760 C). A pouring temperature in excess of 1400 F (760 C) usually results in coarse grained castings and "hot cracks" may occur in some castings.

In pouring, the lip of the ladle should be held as close as possible to the pouring sprue and efforts to avoid splashing, impingement, and aspiration of air must be taken. It is good practice to "touch up" rapidly shrinking risers with hot metal as solidification takes place. The risers of castings exceeding 1/2-lb usually require "touching up" with hot metal.

Pouring practice with pure aluminum must be given strict supervision to insure that sound castings will be obtained. The authors feel that poor pouring prac-

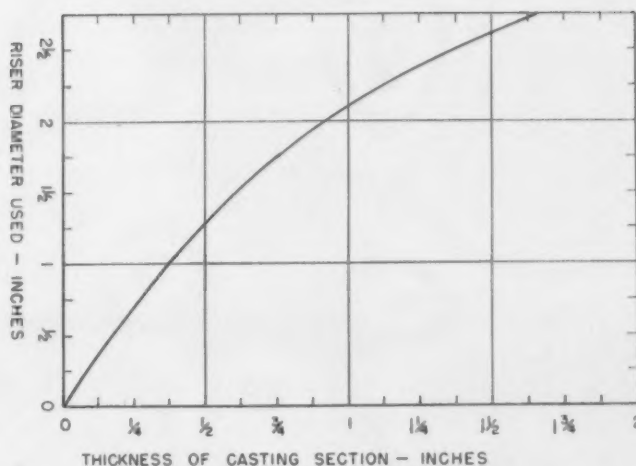


Fig. 2 — Relation of riser diameter to casting section.

tice negates all the other techniques used to produce sound castings, especially in pure aluminum castings, and that high scrap percentages can generally be traced to poor pouring practices.

GATING AND RISERING OF PURE ALUMINUM CASTINGS

The design of gating and risering systems for sand castings of commercially pure aluminum are designed with these objectives in mind:

- 1) To provide for feeding castings with a high solidification shrinkage metal.
- 2) To introduce metal to the mold cavity with a minimum of turbulence.
- 3) To provide a controlled pouring rate gating system to avoid misruns on the one hand and burn-in or washed sand on the other.
- 4) To introduce metal into the mold cavity at locations conducive to producing temperature gradients that provide for directional solidification.

Risering

When considering riser dimensions, one must remember that 0.066 lb of feed metal are required for each pound of casting. Side risers of commercially pure aluminum will supply about 0.06–0.15 lb of feed metal for each pound of riser.

Riser diameters vary with casting section and each individual casting configuration affects the riser to casting relationship. The plot shown in Fig. 2 gives the approximate relationship, found by practical experience, of riser diameter to casting section necessary to feed castings considered of average difficulty to feed. Extreme shrinkage conditions would require wide variation from this plot.

Riser heights are 1.5 to 2.25 times the riser diameter. During solidification riser piping is very deep and confined closely to the center line of the riser.

The riser connections to the castings should be as large as the method of gate removal will allow. Riser connections of 90 per cent of casting section are usual. The connection should be kept as short as possible. Situations where the riser to casting connection will freeze first during solidification should be avoided.

Gating

Gating systems resemble those used in common

aluminum alloy sand castings with the exception that the downsprue and runner cross-sectional areas are larger per lb of casting. This is necessary to fill the large riser requirements while maintaining good pouring speed.

Gating through the risers is essential to the production of sound castings.

Patternmaker's Shrinkage Allowance

The patternmakers shrinkage allowance of 3/16-in. per ft is used in making patterns for castings of commercially pure aluminum.

SAND PRACTICE

Molding sands applicable to the production of aluminum alloy sand castings are suitable for use in casting commercially pure aluminum. Anderson Electric uses a synthetic sand prepared from rounded grain washed New Jersey silica sand of AFS gfn 160 and southern bentonite. This sand mixture produces fine finished castings. In large castings where expansion problems are encountered the use of wood flour or cereal is used to control this factor.

Molding sand of the following specifications generally gives good results when pouring commercially pure aluminum:

AFS grain size	130-160
AFS clay content, %	10.0
Permeability, AFS	28-32
Green compressive strength, psi	12.0-15.0
Moisture, %	3.8-4.3

Shakeout

Castings of commercially pure aluminum are easily deformed in the shakeout. To prevent this deformation time must be allowed for castings to cool well below the solidification range before shaking out of the molds. The castings must be handled with care from this point on through the finishing operations. Due to the softness of the castings they are easily scratched and marred with rough handling.

SAWING AND GRINDING

The extreme softness of the pure aluminum castings presents a problem in the removal of the gates and risers. When sawing is used the band-saw blades should be very rugged, preferably 1/2-in. wide and 0.025 in. thick with about 4 teeth per in. Cutting is fast with a hook-tooth blade provided the blade is sharp. Loading quickly occurs when the blade is dull and poor cutting results. Cutting speeds of 3000-4000 ft per min are used. Abrasive belts of 36 grit are used for fast cutting with a choice of finer grits for finishing.

ANNEALING OF PURE ALUMINUM CASTINGS

In applications where the castings are to be subse-

quently subjected to cold-working, it is usually necessary to anneal the castings. Anderson Electric's annealing practice is to hold castings at 750 F (399 C) for 1-2 hr, furnace cool to 500 F (260 C) at a rate not exceeding 50 F (28 C) per hr, and air cool below 500 F (260 C). Excellent results have been obtained from this treatment.

MECHANICAL AND ELECTRICAL PROPERTIES

The mechanical and electrical properties expected of commercially pure aluminum are given in Tables 2 and 3 which follow. The mechanical properties are typical mechanical properties obtained from separately cast test bar results. The electrical properties were obtained from cast conductivity bars, 1/2-in. diameter rounds, and from machining sections from ingots.

Mechanical Properties

The following table gives the typical mechanical properties that may be expected of separately cast pure aluminum test bars.

TABLE 2 — TYPICAL MECHANICAL PROPERTIES OF COMMERCIAL PURE ALUMINUM SAND CASTINGS FROM SEPARATELY CAST TEST BARS

Tensile strength, psi	11,500
Yield strength (0.2% offset), psi	3,500
Elongation, % in 2 in.	34

Electrical Properties

The weight conductivity of separately cast bars, 1/2-in. in diameter, was determined by use of a Kelvin Bridge. The weight conductivity was converted to volume conductivity using standard conversion factors. The volume conductivity of ingot is determined by the use of the Kelvin Bridge on a 1/2-in. rod machined from an ingot section. The results shown in Table 3 are the values to be expected from typical ingot and sand castings.

TABLE 3 — ELECTRICAL CONDUCTIVITY OF PURE ALUMINUM SAND CASTINGS AND INGOT

	Volume conductivity, %, I.A.C.S.
Sand cast bar (50% ingot — 50% foundry returns)	57.8
Ingot section (Al content 99.70%)	59.8

SUMMARY

A review of one foundry's practice in sand casting commercially pure aluminum has been presented.

The authors feel that with reasonable adherence to good casting practice pure aluminum castings, free from defects, can be produced as easily as with common aluminum casting alloys. The scrap percentage at Anderson Electric is less with pure aluminum castings than with A.S.T.M. alloy SG70A (Commercial Designation 356).

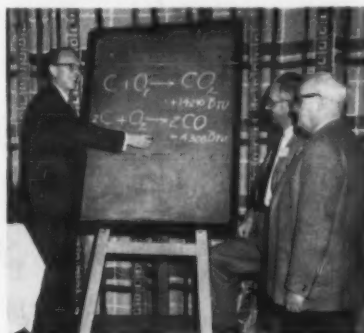
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Ontario T&RI Course Draws from Canada, United States

Fifty-nine students from two Canadian provinces and four states south of the Canadian border attended the two-day *Cupola Melting of Iron* course presented March 17-18 at Hamilton, Ont., Canada.

The course was initiated and sponsored by the AFS Ontario Chapter



Instructor Howard Wilder, Vanadium Corp of America, Chicago, illustrates a point to J. Wallace, Canadian Westinghouse Co. Ltd., Hamilton, Ont. and R. C. Vollick, also of Canadian Westinghouse.

and presented with the cooperation of the AFS Training & Research Institute.

This is the second Chapter-sponsored program presented by the T&RI. A previous *Cupola Melting of Iron* course was given in February in cooperation with the Northern California Chapter.

Four instructors participated in presenting the course designed for upgrading foundry supervision. The instructors were: Howard H. Wilder, Vanadium Corp. of America, Chicago; R. W. Carpenter and E. J. Burke,

Hanna Furnace Corp., Buffalo, N. Y., and T&RI Director S. C. Massari.

A survey of enrollees shows that foremen and metallurgists accounted for more than half of the students. The course emphasized the following major subjects:

Cupola Design & Construction,
Raw Materials Purchasing,
Coke,
Preparation & Operation,
Essential Records,
Desulphurization,
Combustion Control,
Temperature Measurement,
Metallurgy of Cast Iron,
Operating Problems.



Instructor R. W. Carpenter, Hanna Furnace Corp., Buffalo, N.Y., on right reviews course materials with Donald Smith and Lyman Pellett, Bennett-Ireland, Inc., Norwich, N.Y.; C. H. Pool, Debevoise-Anderson Co., New York; and G. Kelly and H. Leng, Wabi Iron Works Ltd., New Liskeard, Ont.

Each student was presented with the Institute of Scrap Iron & Steel *Specifications for Scrap* as a supplement to the class on raw materials

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Students from Canada and the United States attended the regional foundry training course *Cupola Melting of Iron*, given by the AFS Training & Research Institute and sponsored by the Ontario Chapter.



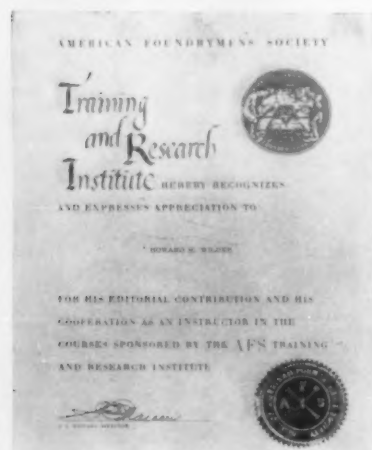
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Ontario T&RI Course

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conducted by S. C. Massari. Topics covered included various types of cast and wrought scrap, gray iron and steel borings and turnings, steel punchings, available varieties of pig iron, ferro alloys, silvery pig, fluxes, inoculating alloys and fuel.



Certificate of appreciation given to instructors who donate their time to assist in presenting T&RI courses.

Those assisting T&RI personnel included National Director Alex Pirrie, American-Standard Products, Ltd., Toronto, Ont.; Ontario Chapter Chairman John Perkins, Ford Motor Co. of Canada, Ltd., Windsor, Ont.; Ontario Chapter 1st Vice-Chairman J. M. Hughes, Stevenson & Kellogg, Ltd., Toronto Ont.; Chapter Educational Chairman Robert Gray, Canadian Westinghouse Co., Ltd., Hamilton, Ont.; and Chapter Director L. H. Burbage, Otis Elevator Co., Ltd., Hamilton, Ont.

No T&RI courses are scheduled for May. The program will be resumed in June with one course, Sand Testing, to be held June 2-6 in Chicago. The Metallography of Non-Ferrous Metals course originally scheduled for June 25-27 in Detroit has been changed to Sept. 15-17.

R. E. Betterley, T&RI Training Supervisor, states that the caliber of men attending was exceptional and a high level of interest was main-

tained. Betterley, who conducted the achievement test given at the conclusion of the course, remarked that the results indicated enrollees were deriving considerable benefit from the program.

Japanese Team Will Visit Convention on 6-Week Tour

■ A 13-man Japanese foundry management study team will participate in a 6-week study of foundry organization and management and will attend the 62d Castings Congress & Foundry Show to be held in Cleveland May 19-23.

The team will arrive in San Francisco May 14 and after a 3-day tour of the San Francisco area will fly to Cleveland. Participants, with the exception of two labor representatives, occupy management positions in small and medium size foundries. Their study objectives are directed at both ferrous and non-ferrous foundries. A visit will be made to the AFS Headquarters, Des Plaines, Ill.

Activities of AFS Explained in Folder

■ Activities of the American Foundrymen's Society are explained in a pocket-sized 16-p folder entitled This is AFS. The recently published booklet gives a concise report on the broad range of functions supported by the Society.

Included are sections on technical activities, manpower training, Foundry Instructors Seminar, Robert E. Kennedy Memorial Apprentice Contest, technical library, Castings Congress, Foundry Show, Engineered Castings Show, membership growth and classifications, chapter functions, regional conferences, awards and citations, technical publications, Safety, Hygiene and Air Pollution Control Program, MODERN CASTINGS, and the BUYERS DIRECTORY.

Copies have been mailed to membership chairmen of each chapter.

Featured in the booklet is a graphical presentation of the growth of the Society as well as a listing of all chapters and student chapters and their headquarter city.

Ductile Iron Division Elects Officers and Charts Course for Technical Work

■ The Ductile Iron Division has gotten off to an official start with the election of officers, outlining of technical activities, and the selecting of committee chairmen.

Officers who had been serving on a temporary basis were elected unanimously by letter ballot. The officers are:

Chairman—C. W. Gilchrist, Cooper-Bessemer Corp., Mt. Vernon, Ohio.
Vice-Chairman—C. W. Ray, Deere & Co., Moline, Ill.

Secretary—David Matter, Ohio Ferro Alloys Corp., Canton, Ohio.

Division committees were formed as a result of studies made by members of the division.

The following committees were formed:

Melting Methods Committee, Chairman Eric Welander, John Deere Malleable Works, East Moline, Ill. Committee plans to investigate and evaluate the types of melting equipment. As its initial project a symposium of ductile iron melting methods will be presented at the 1959 Convention in Chicago.

Basic Metallurgy Committee, Chairman Keith D. Millis, International Nickel Co., New York. Committee will study the problems of basic metallurgy relating to the production of ductile iron but avoid overlapping in other committee activities.

Gating & Riserings Committee,

Chairman T. W. Curry, Lynchburg Foundry Co., Lynchburg, Va. This committee is to collect and appraise methods now in use for gating and risering of castings and apply them to the casting of ductile iron.

Alloying Committee, Chairman Al J. Fruchtl, J. B. Clow & Sons, Inc., Coshocton, Ohio. Committee is to make a study of methods and alloys used for the nodulizing process including late alloy additions.

Welding Committee, Chairman Harold W. Ruf, Grede Foundries, Inc., Milwaukee. Ruf suggested that the division maintain a close liaison with the present A.W.S.-AFS Committee on Welding Iron Castings, Gray Iron Division. Plans were made to request appointment of one of its members to this committee.

Quality Control Committee, Chairman C. K. Donoho, American Cast Iron Pipe Co., Birmingham, Ala. The scope of work to be defined at a later date.

Heat Treatment Committee, Chairman W. D. McMillan, International Harvester Co., Chicago. This committee will study the heat treatment of ductile iron, both complete and selective.

It was suggested that one of its first undertakings would be the establishment of upper and lower critical temperatures as affected by variations in chemistry.

Western Michigan University Offers 2-Year Foundry Technology Program

■ Details on a new 2-year foundry technology course to be offered in September by Western Michigan University were announced April 2 at a dinner held on the University campus, Kalamazoo, Mich.

The dinner was sponsored by the Foundry Industry Advisory Committee, Department of Industrial Technology. This committee, headed by Thomas T. Lloyd, Albion Malleable Iron Co., Albion, Mich., was organized in August, 1957 to develop a 2-year foundry curriculum.

Speakers for the evening and their subjects were: T. T. Lloyd, *Technical Institute Training in the United States*; Dr. Andrew C. Luff, Department of Industrial Technology, Western Michigan University, *Industry Oriented Programs at Western Michigan University*; Frank G. Steinebach,



Thomas T. Lloyd, Chairman, Foundry Industry Advisory Committee.

Penton Publishing Co., *Economics and Technical Education*.

A panel discussion was conducted on industry-education relations. Pan-

Western Michigan

Continued from page 144

elists were Fitz Coghlin, Jr., Dock Foundry Co., Three Rivers, Mich.; Robert A. Huston, Fuller Mfg. Co., Kalamazoo, Mich.; T. T. Lloyd; and Dr. A. C. Luff.

Members of the Committee are: Fitz Coghlin, Jr.; Robert Cope, Rapidcast Corp., Grand Rapids, Mich.; Horace Deane, Campbell, Wyant & Cannon Foundry Co., Muskegon, Mich.; George Garvey, Garvey Pattern Co., South Bend, Ind.; Ross Gilmore, Superior Steel & Malleable Castings Co., Benton Harbor, Mich.; William Hambley, foundry consultant, Birmingham, Mich.; Albert Rhoads, Engineering Castings, Inc., Marshall, Mich.; Harold Westenheiser, U. S. Foundry Corp., Kalamazoo, Mich.; and Charles Yaker, Misco Precision Casting Co., Whitehall, Mich. Ex-officio members are Dr. Luff and R. A. Huston.

International Cooperation Assignment Takes Prof. Sigerfoos to Costa Rica

■ C. C. Sigerfoos, Associate Professor, Mechanical Engineering Department, Michigan State University, East Lansing, Mich., is currently on a three month International Cooperation Administration assignment with the foundries and machine shops of Costa Rica.

Objectives of the assignment are to make improvements in the present methods and materials; improvement of quality and production schedules;

FIRST YEAR
First Semester
Communications
Molding & Coremaking
Industrial Processes
Trigonometry and College Algebra or
Intermediate Algebra
Industrial Calculators

Second Semester
Communications
Foundry Metallurgy
Industrial Processes
College Algebra and
Analytic Geometry

SECOND YEAR
First Semester
Physical Science
Industrial Relations
Production Techniques
Technical Drafting
Physical Education
Plant Maintenance

Second Semester
Physical Science
Control Procedures
Technical Electricity
Physical Education
Technical Electives

and promotion of the use of Costa Rica raw materials such as scrap metals, molding sands, bentonite, and fire clays.

Sigerfoos is also conducting evening training courses on foundry and machine shop methods.

The courses are attended by owners and operators of Costa Rican foundries and machine shops in the vicinity of San Jose, the capital city.



Tapping the cupola of a San Jose, Costa Rica, foundry. Left to right, front row, are: A. Ortiz, cupola operator; Prof. Sigerfoos, Michigan State University, on International Cooperation Administration assignment in Costa Rica; Eduardo Rojas, owner, Tallery Fundicion Lalo Rojas factory; Alberto Golcher, interpreter for the Costa Rican Industry Development Center.

Society's Technical Program to be Planned by Council and Divisions

Technical programs will be planned, reviewed and coordinated June 5-6 at the Hotel Sherman in Chicago by AFS divisions, committees and the Technical Council.

Executive and Program & Papers Committees of the Society's divisions and General Interest Committees will meet Monday, June 5 to plan their individual activities. Division work during the past year will also be reviewed.

On Tuesday the Technical Council will meet to plan and coordinate the entire technical program. The Council is composed of Chairmen and Vice-Chairmen from each of the divisions and general interest committees.

James S. Vanick, Technical Council Chairman, and L. H. Durdin, Technical Council Vice-Chairman, will preside.

Members of the Technical Council:

Brass & Bronze Division—Chairman, R. J. Keeley; Vice-Chairman, R. B. Fischer.
Education Division—Chairman, B. L. Bevis; Vice-Chairman, R. W. Schroeder.
Gray Iron Division—Chairman, H. W. Lownie; Vice-Chairman, R. A. Clark.
Light Metals Division—Chairman, D. L. LaVelle; Vice-Chairman, J. G. Mezoff.

Malleable Division—Chairman, Eric Welander; Vice-Chairman, F. W. Jacobs.

Pattern Division—Chairman, J. F. Roth; Vice-Chairman, O. C. Bueg.

Sand Division—Chairman, E. C. Zirzow; Vice-Chairman, L. J. Pedicini.

Steel Division—Chairman, A. J. Kiesler; Vice-Chairman, D. N. Rosenblatt.

Die Casting & Permanent Mold Division—Chairman, D. L. Colwell; Vice-Chairman, F. C. Bennett.

Ductile Iron Division—Chairman, C. W. Gilchrist; Vice-Chairman, C. W. Ray.

Fundamental Papers Committee—Chairman, H. F. Taylor.

Heat Transfer Committee—Chairman, W. K. Bock.

Plaster Mold Casting Committee—Chairman, R. F. Dalton.

Industrial Engineering & Cost Committee—Chairman, L. W. Lehmann.

Plant & Plant Equipment Committee—Chairman, James Thomson.

Refractories Manual Committee—Chairman, R. H. Stone.

Cupola Advisory Committee—Chairman, W. W. Levi.

Management Development Committee—Chairman, C. E. Westover.

Safety, Hygiene & Air Pollution Control Committee—J. R. Allan.

AMERICAN FOUNDRYMEN'S SOCIETY OFFICIAL SCHEDULE OF EVENTS

June 2-6	T&RI Training Course, Sand Testing—Rackham Memorial Detroit.
June 5	AFS Division Meetings, Executive Committees, Program & Papers Committees, Annual Review, Chicago.
June 6	AFS Technical Council, Annual Meeting, Chicago.
June 11	AFS Board Orientation Meeting—AFS Central Office, Des Plaines, Ill.
June 12-13	AFS 15th Annual Chapter Officers Conference—Hotel Sherman, Chicago.
June 16	AFS Publications Committee, annual meeting, Chicago.
June 19-21	AFS 3d Annual Foundry Instructors Seminar, Case Institute of Technology, Cleveland.
June 20	T&RI Research Committee, Annual Meeting—Chicago.
June 25-27	T&RI Training Course, Metallography of Cast Metals, Hamilton Hotel, Chicago.
June 27	AFS Exhibits Committee 1958-59, Chicago.

Committees in Action

Heat Transfer Clinic Slated for Convention

■ In an effort to stimulate audience participation in discussing heat transfer problems at the 62d Castings Congress, the Heat Transfer Committee will sponsor a panel discussion in lieu of technical papers at the Friday 9:00 am session.

The panel will represent ferrous and non-ferrous branches of the industry as well as laboratory and operating personnel. Members of the panel are J. B. Caine, consultant, Cincinnati; C. K. Donoho, American Cast Iron Pipe Co., Birmingham, Ala.; Dr. Victor Paschkis, Columbia University, New York; R. W. Ruddle, Foundry Services, Inc., Columbus, Ohio; R. C. Shnay, Canada Iron Foundries Ltd., Toronto, Ont.; and Walter E. Sicha, Aluminum Co. of America, Cleveland.

Heat Transfer Committee Chairman Dr. W. K. Bock, National Malleable & Steel Castings Co., Cleveland states that direction of the discussion will depend upon the questions submitted by the audience.

Committee 8N Clarifies Work with Title Change

■ Members of the 8N Committee at the February meeting held in Chicago voted to change the committee name from Shell Molding Materials Testing Committee to Shell Mold & Core Committee to more clearly define the scope of its operations.

Officers were also elected to serve 2-year terms starting in March. Officers:

Chairman—R. A. Rabe, General Motors Corp., Detroit.

Vice-Chairman—Jack E. Bolt, General Electric Co., Pittsfield, Mass.

Secretary—Roderick J. Cowles, Walworth Co., South Boston, Mass.

Work is being continued by the committee with shell mold expansion tests using the same sand and resin mixes used in earlier tests. The committee was also instructed to prepare its material for the revision of the **FOUNDRY SAND TESTING HANDBOOK**.

Erosion of Steel Foundry Sands Chosen as Project

■ Erosion of steel foundry sands has been selected as a new project by the Sand Division Committee on Physical Properties of Steel Foundry Sands at Elevated Temperatures. The com-

mittee will seek to develop a test useful to steel foundrymen for pre-evaluating the tendency of a given sand to erode in a mold.

The committee at its March meeting in Chicago also selected a tentative design of a test casting to evaluate erosion. They will be made following approval of the final design.

Ontario Chapter Hears Two Speakers

■ A field trip to the ingot shop of Canadian Iron Foundries, Ltd., was attended by 62 members prior to the February technical meeting. The visitors observed the use of plastics in patternmaking.

Two speakers addressed 185 foundrymen at the evening meeting. R. H. Smith, Hysol (Canada) Ltd., Toronto, Ont., discussed *Plastic Patterns*. S. A. Yasko, Westinghouse Electric Co., Schenectady, N. Y., spoke on *Welding and Brazing of Castings*.—*Jack Anderson*



Shown inspecting plastic pattern at the Ontario Chapter meeting are Chapter Secretary J. W. Wallace and Willard Jones, Canadian Westinghouse Co., Ltd., Hamilton, Ont., and speaker R. H. Smith, Hysol (Canada) Ltd, Toronto, Ont.

Central Ohio Chapter Air Pollution Talk

■ Air pollution laws affecting foundries were discussed at the March meeting by H. J. Weber, AFS Director of Safety, Hygiene & Air Pollution. Weber stated that unless communities stop extending the so-called A.S.M.E. model smoke ordinance to metal melting operations, foundries, smelters and steel mills will be unfairly penalized.

Applying Ringelmann charts, CO₂ and stack temperature adjustments to process furnaces is unscientific since such means of determining emissions have meaning only when applied to equipment designed primarily for fuel burning, Weber emphasized.—*Jose B. Acebo.*

Chapter News

Washington Holds Local Apprentice Contest

■ Apprentices from the Puget Sound Naval Shipyard dominated the Washington Chapter local elimination contest in the AFS Robert E. Kennedy Memorial Apprentice Contest. Shipyard entries won first place in the three molding divisions.

Twenty-one apprentices entered the contest. Each first place winner received an engraved bronze plaque.

The winners:

Iron Molding—1st place, David L. Haynes, Puget Sound Naval Shipyard; tied for 2d and 3d places, Gaile D. Canfield, Atlas Foundry & Machine Co., and Antonio Dilorio, Washington Iron Works.

Steel Molding—1st place, Dennis M.

Jenniges, Puget Sound Naval Shipyard; 2d place, James Fazio, Atlas Foundry & Machine Co.; tied for 3d place, Robert T. Lyons, Washington Iron Works, and Naaman Peterson, Puget Sound Naval Shipyard.

Non-Ferrous Molding—1st place, Wayne J. Bernhard, Puget Sound Naval Shipyard, 2d place, Roy McElroy, Sunset Foundry; 3d place, Bob Lemke, Peterson Pattern Works.

Wood Patternmaking—1st place, Ronald Aldridge, Eagle Pattern Works; 2d place, Ralph S. Bussacker, Puget Sound Naval Shipyard; 3d place, Donald B. Boot, Morel Foundry.



Apprentice Contest Chairman Quentin Tracy, Salmon Bay Foundry Co., Inc., Seattle, Wash., congratulates winners in the Washington Chapter apprentice elimination contest. Left to right are: Ronald Aldridge, Donald B. Boot, Roy McElroy, Antonio Dilorio, Gaile Canfield, and James Fazio.—*Fred R. Young*



Shown at the Washington Chapter March meeting are Publicity Chairman Frank H. Jefferson, Frank H. Jefferson, Inc., Seattle, Wash.; Program chairman Vernon W. Rowe, Ballard Pattern & Brass Foundry, Seattle, Wash.; speaker O. J. Myers; Chairman William K. Gibb, Atlas Foundry & Machine Co., Tacoma, Wash. With back to camera is Harry McDaniels, Atlas Foundry & Machine Co., Tacoma, Wash.—*Fred R. Young*

Pittsburgh Discusses Recent Molding Developments



Recent developments in molding in the foundry were explained at the March meeting by Dr. David C. Ekey, School of Industrial Engineering, Georgia Institute of Technology. The speaker discussed the work functions of molding machines with emphasis on standard time data and a typical foundry layout. Seated in photo are Technical Chairman H. E. Gebhard, Blaw-Knox Corp., Pittsburgh; speaker Ekey; and Chapter Vice-Chairman I. W. Sharp, American Steel Foundries, Verona, Pa. Standing are two students from Georgia Institute of Technology, K. J. Dolan and L. H. Alkofer.—Walter Napp



Six new members joined the Pittsburgh Chapter at the March meeting. Seated are John V. Haider, Pangborn Corp.; Herbert Cooper, Burd Cooper & Brass Co.; and R. L. Williams, North American Smelting Co. Standing are F. E. Donnelly, Pittsburgh Brass Mfg. Co.; A. R. Patterson, and Gerald Decutner, both of Homestead Valve & Mfg. Co.



Cleaning shop practices were discussed at the March meeting of the Eastern Canada Chapter by three speakers. Shown left to right are Chapter Vice-Chairman Max Reading, Foundry Services (Canada), Ltd., Beaurepaire, Que.; speaker Roy Chamberlain, Dominion Engineering Works, Montreal, Que.; Henry Louette, Warden King, Ltd., Montreal, Que.; Chapter Chairman Paul Von Colditz, Canadian Steel Foundries (1956) Ltd., Montreal, Que.; speaker R. S. Snutch, Canadian Steel Foundries (1956), Ltd., Montreal, Que.; speaker N. R. Woods, Montreal Bronze Co., Ltd., Montreal, Que.; Kenneth Scanlon, Canadian Foundry & Pattern Works, Ltd., Montreal, Que.

Mexico Chapter

Elects New Officers

Officers and directors were elected at the February meeting of the Mexico Chapter. Subjects to be presented at future meetings were also discussed.

Officers and Directors:

Chairman—Vincente Nacher Todo, La Consolidada, S.A., Mexico, D.F., Mexico.

Vice-Chairman—Luis Delgado Vega, Cia. Proveedora de Industrias S.A., Mexico, D.F., Mexico.

Secretary—Enrique Leon Andrade, Teziutlan Copper Co., S.A., Mexico, D.F., Mexico.

Treasurer—Eduardo Zalce, Fierro Es-maltado, S. De R.L., Mexico, D.F., Mexico.

Directors, terms expire 1950—Jose A. Perez Cacas, La Consolidada, S.A., Mexico, D.F., Mexico; Enrique Delgado Vega, Cia. Proveedora de Industrias, S.A., Mexico, D.F., Mexico; Joseph Krishon, Mueller Brass de Mexico, S.A., Mexico, D.F., Mexico.

Among the topics planned for future discussion are nodular iron, non-ferrous alloys, light alloys, casting problems, heat treating and combustion in the cupola furnace.

Other subjects are technical production of manganese steels, stainless steels, nitriding of castings, self-tempering manganese steel, molding clays and sands, mechanical properties of castings and the influence of chemical composition on the characteristics of metals.—Jose A. Perez Cacas

Mo-Kan Chapter

Learns Sand Fundamentals

Sand fundamentals were discussed at the March meeting by C. E. Winninger, Beardsley & Piper Div., Pettibone Mulliken Corp., Chicago. Chapter Chairman T. F. Shadwick, Witte Engine Works, Kansas City, Mo., presided.—J. T. Schlanker

Washington Chapter

Use of Exothermic Materials

Theories of the mechanics of metals solidification, emphasizing the relations of heat transfer problems to various metals, temperatures and casting size were outlined at the February meeting by Don E. Wyman, Exomet, Inc., Conneaut, Ohio. These are among the factors to consider in using highly exothermic materials as well as the moldable and insulating materials.

Wyman stated emphasis today on casting quality and closer specifications has resulted in increased use of feeding aids.—Frank H. Jefferson

Philadelphia Chapter

Safety for Foundrymen

An illustrated talk on safety equipment and practices used at Bethlehem Steel Co., was presented at the March meeting by Richard R. Willy, Bethlehem Steel Co., Bethlehem, Pa. All phases of foundry safety practices were covered. William A. Morley, Link-Belt Co., Philadelphia, served as technical chairman. National Director A. A. Hochrein, American Smelting & Refining Co., Baltimore, Md., attended.



Shown left to right at Philadelphia meeting are John Peabody, Bethlehem Steel Co., Bethlehem, Pa.; speaker R. R. Willy; Technical Chairman William A. Morley, Link-Belt Co., Philadelphia; Harry Reiting, consultant, Philadelphia.

Quad-City Chapter

Holds Management Night

More than 125 foundrymen attended the March meeting designated as "Management Night." T. A. Boyd, General Motors Corp., discussed his book *Professional Amateur*, a biography of Charles F. Kettering, former general manager, General Motors Research staff.—William T. Ellison.

Toledo Chapter

Elects Officers, Directors

Officers and directors for the 1958-59 season have been elected.

Chairman—Richard E. Bossert, Mautsee Malleable Castings Co., Toledo, Ohio.

Vice-Chairman—Thaddeus Giszczak, Central Foundry Div., GMC, Defiance, Ohio.

Secretary—LeRoy F. Schultz, Free-man Supply Co., Toledo, Ohio.

Treasurer—Warren A. Burwell, Railroad Products Div., American Brake Shoe Co., Toledo, Ohio.

Directors—(Terms expire 1961) Joseph Tillman III, Unitcast Corp., Toledo, Ohio; Fred Showers, Monroe Steel Castings Co., Monroe, Mich.; Paul Sharrock, Bunting Brass & Bronze Co., Toledo, Ohio; Martin J. Gruhler, Unitcast Corp., Toledo, Ohio.—L. F. Schultz.

Oregon Chapter's Local Apprentice Contest Draws Entries in Each of Five Divisions



Photos by Bill Hughes and Bill Walkins.

■ Oregon Chapter's annual apprentice contest was conducted in February with 13 apprentices entering in the five divisions. Winning entries were submitted in the national contest.

Winners shown in photo at left are Charles L. Wanless, Northwest Foundry & Furnace Co., *Iron Molding*; James Rogers, Oregon Steel Foundry Co., *Steel Molding*; Carl Williams, Pacific Chain & Mfg. Co., *Non-Ferrous Molding*; Norbert Aicher, Willamette Pattern Works, *Wood Patternmaking*; Richard D. Rudig, Dependable Pattern Works, *Metal Patternmaking*.

Shown judging steel molding entries at upper left are Phil Laugen, Oregon Steel Foundry; Tony Kavan, Western Steel Castings Co.; and Phil Ramage, Electric Steel Co.

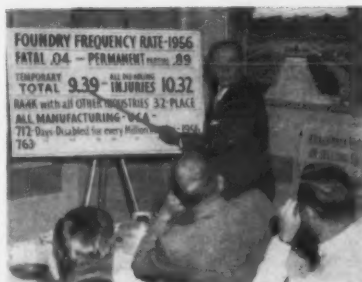
Judging the metal patternmaking entries in lower right are Willie Kaster, Willamette Pattern Works; George Battin, Northwest Pattern Works; and Harry Emslie, Precision Pattern Works.

East Texas Section Stresses Foundry Safety

■ "Selling safety pays dividends", W. P. Leonard, Jr. Southland Corp., Dallas, Texas, told 46 members and guests of the East Texas Chapter at a meeting in Tyler, Texas.

Leonard outlined ways and means of initiating and securing cooperation of all employees in plant-wide safety programs, emphasizing the importance of a direct interest by management and supervisors. Statistics were presented for the foundry and metals industry as well as accident figures for school, community, traffic safety and off-the-job activities.

The value of an effective safety program was illustrated with figures on the cost per ton for Workmen's



Compensation Insurance. In 1956, 122 foundries representing 47,645 employees in eight divisions paid an average of \$3.16 per ton for the insurance. The minimum paid was \$1.27 or a saving of \$1.89 per ton.



Theme of the meeting emphasized with this banner. In photo are E. E. Pollard, Tyler Pipe & Foundry Co., Tyler, Texas; C. L. Boice, McBride Pattern Works, Longview, Texas; F. W. Jacobs, Texas Foundries, Inc., Lufkin, Texas; H. E. Bland, Brewster Co., Shreveport, La.

Saginaw Valley Student-Teacher Night

■ Approximately 118 instructors and students from senior and junior high schools attended the March meeting devoted to studying industry-education problems.

Chapter Chairman Vernon J. Sadler, General Foundry & Mfg. Co., Flint, Mich., outlined the purpose and functions of AFS and the Foundry Educational Foundation.

Dr. Richard A. Flinn, University of Michigan, Ann Arbor, Mich., discussed some of the phases of engineering work being conducted by post-graduate students. Dr. Austen

J. Smith, Michigan State University, East Lansing, Mich., talked on the cooperative work being carried on between industry and students. Donald A. Bergh, General Motors Institute, GMC, spoke on industry's problem of obtaining engineers.

Three student speakers were introduced by Chapter Education Committee Chairman John Lowe, General Motors Institute. Speakers and their subjects were: Chester Mielke, *Current Research in Pressure Tightness in Bronze Castings*; Richard D. Smith, *Student Summer Employment in the Foundry*; Thomas Fancher, *Improved Core and Molding Methods*.—R. J. Gleffe



Attending the Saginaw Valley Student-Teacher night in March are Thomas Fancher, student, General Motors Institute; Donald Bergh, instructor, General Motors Institute; Dr. Austen J. Smith, head, Department of Mechanical Engineering, College of Engineering, Michigan State University; Chapter Chairman Vernon J. Sadler, General Foundry & Mfg. Co. Flint, Mich.; John Lowe, General Motors Institute and Chapter Educational Committee Chairman; Richard D. Smith student, Michigan State University; Dr. Richard A. Flinn, professor, Metallurgical Engineering, University of Michigan; and Chester Mielke, student, University of Michigan.—R. J. Gleffe

British Columbia Holds Management Night



Management Night was conducted March 5 and attended by personnel from foundries and patternshops in the chapter area. Photo shows Chapter Chairman E. C. J. Bird addressing the group. Others at the head table are Chapter Vice-Chairman J. T. Hornby, Balfour Guthrie (Canada) Ltd.; C. C. Smith, General Metals; National Director Herbert Heaton, Mainland Foundry Co., Ltd.; Dean H. Goard, principal, Vancouver Vocational Institute; Chapter Director W. C. Catherall, Vancouver Technical Institute; and Chapter Secretary-Treasurer G. E. Stephens, Railway & Power Engineering Corp.



Portion of crowd attending the British Columbia Chapter's Management night.

Central Indiana Chapter Talk on Foundry Practices

■ Harry H. Kessler, Sorbo-Mat Process Engineers, St. Louis, addressed the March meeting. Fred E. Kurtz, Electric Steel Castings Co., Indianapolis, served as technical chairman.—William R. Patrick



New England Chapter President Alexander Beck, Whitman Foundry Inc., Whitman, Mass., congratulates the March speaker, Lewis W. Greenslade.



Herbert J. Weber, AFS Director of Safety, Hygiene and Air Pollution Control, spoke to the Tri-State Chapter in March on Air Pollution Legislation Affecting Foundries. Left to right are Chapter Chairman Edward O'Brien, Oklahoma Steel Castings Co., Tulsa, Okla.; speaker Weber; and Chapter Vice-Chairman E. F. Hines, Nemco Foundry Co., Tulsa, Okla. Leslie O'Brien

New England Chapter Gatering & Riserling

■ An illustrated lecture on gating and risering practices employed by Brown & Sharpe Mfg. Co. were reviewed at the March meeting by Lewis W. Greenslade, foundry super-

intendent. The talk illustrated methods of gating and risering developed over a period of years by Brown & Sharpe.—F. S. Holway

Northwestern Pennsylvania Top Management Night

■ February's meeting was devoted to "Top Management Night" with M. J. Kellner, Westinghouse Electric Co., presenting *Approach to More Profitable Operations in a Foundry*. Kellner was presented with a certificate of appreciation by the chapter.—Walter Napp



Speaker M. J. Kellner receives certificate of appreciation from Chapter Vice-Chairman, W. S. Hodge, W. S. Hodge Foundry, Inc., Greenville, Pa.



Chapter Chairman W. R. Ferguson, Pickands Mather & Co., Erie, Pa., left, talks with Thomas E. Eagan, Cooper-Bessmer Corp., Grove City, Pa. Eagan is a former AFS National Director and was awarded the Joseph S. Seaman Gold Medal in 1954.

Twin City Chapter Gating and Riserling

■ New exothermic and insulating materials were explained to more than 100 foundrymen at the February meeting by Michael Bock II, Exomet, Inc., Conneaut, Ohio.

Successful risering resolves itself down to controlling heat in risers so that they are the last metal in the mold to freeze. Heat can be lost from riser metal by radiation, conduction or convection. Radiation loss is the most influential in the high melting temperature metals as steel and conduction loss affects low melting alloys like aluminum the most.

For aluminum alloys insulating sleeves are an aid in reducing header sizes. In iron and steel, exothermic sleeves actually add heat to the headers to correct for high heat loss through radiation. Mildly exothermic sleeves are successfully used in copper-base alloys.

Two unique feeding practices are practical with the exothermic sleeves. First, the use of ram-up sleeves that can locate a blind riser anywhere on the casting without reference to the parting plane. Second, putting risers on a casting away from the gating area.—J. David Johnson



Speaker Michael Bock II, gesturing, gets varying amounts of agreement from Don Moll, Minneapolis Electric Steel Castings Co., Minneapolis, and Don Fulton, Northern Malleable Iron Co., St. Paul. Chapter Chairman John Uppgren, Northern Ordnance, Inc., Minneapolis, appears on right.



More than 200 members and guests of the Detroit Chapter attended the February meeting featuring a panel discussion on casting cleaning. Participating were Harry Gravlin, John Anderson and L. H. Tinney, Chrysler Corp.; T. R. Schroeder, Pontiac Motor Car Div., GMC; and R. W. Gardner, Ford Motor Co. —Edwin A. Swenson

Northeastern Ohio

Producing Sound Castings

■ AFS chapter members and the Cleveland chapter of the Non-Ferrous Founders' Society attended a joint meeting in March. Walter E. Sicha, Aluminum Co. of America, Cleveland, discussed *Production of Sound Castings*, particularly aluminum base castings. He cautioned foundrymen not to wait for new techniques for the production of better castings but emphasized that the application of present knowledge will result in improved castings.

Sicha defined and outlined several types of porosity including gas and cope porosity and listed possible solutions for control.—*Edwin Bremer*



Walter Sicha, Aluminum Co. of America, Cleveland, shown on left, addressed the Northeastern Ohio Chapter March meeting on *Production of Sand Castings*. On left is Technical Chairman William G. Gude, managing editor, Foundry—Harold Wheeler

Northeastern Ohio Chapter Participates in TV Show

■ "Modern Metals" will be the theme of a television program to be presented at 5:30-6:00 pm, E.S.T., on KYW-TV, Cleveland. The program known as Breakthrough will be presented through the cooperation of the Northeastern Ohio Chapter's Education Committee and the Cleveland Technical Societies Council, of which the AFS chapter is a member.

The show will be presented on the day prior to the opening of the AFS 62d Castings Congress & Foundry Show and will be telecast over a five-state area.

In 1957 the chapter also participated in a television presentation covering light metal casting.

Washington Chapter Rosin or Resin

■ Various binders used in foundry operations were discussed at the March meeting by O. J. Myers, Reichhold Chemicals, Inc., White Plains, N. Y.

Myers classified binders into either organic or inorganic and illustrated the part that proteins, cereals, oils, and resins contribute. Myers said that alkyls hold great promise in future technological development as a core binder material.—*Frank H. Jefferson*

Rolla Student Chapter

■ Seventy students of the Student Chapter at the Missouri School of Mines, Rolla, Mo., and eight guests from the St. Louis Chapter attended the February meeting of the Student Chapter.

Francis H. Hohn, Scullin Steel Co., St. Louis, spoke on *The Vacuum Degassing of Molten Metals*, discussing the types of vacuum melting furnaces and their effect on the mechanical properties of metals.

Robert Jacoby, chapter advisor, presented ten Foundry Educational Foundation scholarship certificates to students.—*Allan G. Wehr*



Student receives F.E.F. scholarship from Robert Jacoby, Chapter advisor.



Attending the meeting were Robert Wolf, foundry professor; Robert Jacoby, industrial advisor; St. Louis Chapter Chairman J. A. Cannon, Duncan Foundry & Machine Works, Alton, Ill.; speaker Francis Hohn; and Allan Wehr, Chairman of the Student Chapter.

Northern California Core Binder Discussion

■ Core binders, their composition and function were outlined at the March meetings by O. J. Myers, Reichhold Chemicals, Inc., White Plains, N. Y. Various properties were explained and new possibilities for core binders were emphasized.—*Harold Henderson*



Two speakers were featured at the Philadelphia Chapter February meeting. S. T. Walter, Air Reduction Sales Co., New York, and Lowell M. Palmer, American Metaseal Corp., West New York, N. J., spoke on *Rectification of Casting Deficiencies*. Shown in photo are Technical Chairman D. E. Best, Bethlehem Steel Co., Bethlehem, Pa., speakers Palmer and Walter, and Chapter Chairman H. C. Winte, Florence Pipe Foundry & Machine Co., Florence, N. J.—E. C. Klank



Four methods of coremaking were explained at the Central Illinois Chapter in March by O. J. Myers, Reichhold Chemicals, Inc. Among the topics covered were the conventional process of oil and resin, shell process of coated and uncoated sands, self-curing of activated and drying oil and the CO₂ process.—*H. L. Marlatt*

Timberline Chapter Non-Ferrous Melting

■ Non-ferrous melting was outlined at the March meeting by William Ball, Jr., R. Lavin & Sons, Inc., Chicago. Although the talk centered on non-ferrous practices many of the basic principles applied also to ferrous operations. Joseph Taleck, Colorado Pattern Works, Denver, Colo., served as technical chairman.—*D. C. Card*



Participating in the Metropolitan Chapter February meeting were Chapter Chairman Howard E. Voit; Technical Chairman Frank Halligan; and speaker Joseph A. Gitzel.—*John Bing*

Metropolitan Chapter Cores and Core Washes

■ Chemical and physical properties of cores and core washes were discussed at the February meeting by Joseph A. Gitzel, Delta Oil Products Co., Milwaukee.

Gitzel placed special emphasis on the various properties imparted to the sand by different binders. He pointed out the danger of using hygroscopic materials for cores which tend to soak up moisture increasing evolution of gasses. Phenol-type binders used in shell molding and the use of sodium silicate binders in the CO₂ process were also covered.—*C. H. Fetzner*



Attending the February meeting of the Philadelphia Chapter were three Indian engineers learning steelmaking at Bethlehem Steel Co., Bethlehem, Pa. Left to right they are Inder Jit, Suprakash Ghosh, and Devidas Gonorkar.



Recent developments in coremaking were discussed at the March meeting of the British Columbia Chapter by O. J. Myers, Reichhold Chemicals, Inc., White Plains, N. Y., shown on right. With Myers is Chapter Chairman E. C. J. Bird, Bird Aluminum Foundry, Vancouver, B. C.—*J. T. Hornby and S. J. Hatchett*



Shown at the **Washington Chapter** February meeting are Quentin Tracy and James Tracy, Salmon Bay Foundry Co., Seattle; Chapter Vice-Chairman Leon Morel, Jr., Morel Foundry Co., Seattle; Chapter Chairman William K. Gibb, Atlas Foundry & Machine Co., Tacoma, Wash.; speaker Don E. Wyman; Chapter Program Chairman Vernon W. Rowe, Ballard Pattern & Brass Foundry, Seattle; and Publicity Chairman Frank H. Jefferson, Frank H. Jefferson, Inc., Seattle.

New Company Members

■ An increasing number of foundries are securing company memberships in AFS. This entitles the company to a full membership service for an officially designated company representative. In addition it allows company employees within a chapter area to become personal members at the reduced price of \$10. Following are those holding new company memberships and their chapter area.

- Ajax Flex'ble Coupling Co., Westfield, N. Y. (Northwestern Pennsylvania).
- Brown Thermal Development Co., Elyria, Ohio. (Northeastern Ohio).
- Erie Forge & Steel Corp., Erie, Pa. (Northwestern Pennsylvania).
- Graham White Mfg. Co., Salem, Va. (Piedmont).
- Homestead Valve Mfg. Co., Coraopolis, Pa. (Pittsburgh).
- Hunt-Spiller Mfg. Corp., Boston, Mass. (New England).
- Indianapolis Wire Bound Box Co., Fernwood, Miss. (Non-Chapter area).
- Inductotherm Corp., Delanco, N. J. (Philadelphia).
- Laclede Gas Co., St. Louis. (St. Louis).
- Metallurgical Mfg. Co., Brooklyn, N. Y. (Metropolitan).
- Newcomb Detroit Co., Detroit. (Detroit).
- Northwest Olivine Co., Seattle, Wash. (Washington).
- Oregon Metallurgical Co., Albany, Ore. (Oregon).
- Pittsburgh Metallurgical Co., Charleston, S. C. (Piedmont).
- A. Schrader's Son Div., Scovill Mfg. Co., Brooklyn, N. Y. (Metropolitan).
- Simplicity Engineering Co., Durand, Mich. (Saginaw Valley).

Yale & Towne Mfg. Co., Philadelphia. (Philadelphia).
L. R. Zifferer Co., York, Pa. (Chesapeake).

Sustaining Member

■ Sustaining members have unlimited access to all AFS findings and the privilege of making it possible for any number of company employees, regardless of location within country, to hold personal AFS membership at minimum dues of \$10.

Walworth Co., New York, has become a sustaining member in the Metropolitan Chapter area.

Twin City Chapter Epoxy Resins

■ An illustrated lecture on *Epoxy Plastics for Patternmaking* was given at the March meeting by M. K. Young, U.S. Gypsum Co., Chicago.

Young illustrated numerous applications for plastics in patternmaking and tooling. He stated that many patternmakers are now doing jobs that diemakers formerly performed, particularly in the automotive field. The speaker also discussed plastic patternmaking techniques and told of new products available. Step-by-step procedures were illustrated for making plaster and plastic patterns and core boxes.

Chapter Membership Chairman Harry Blumenthal, American Iron & Supply Co., Minneapolis, announced that the membership target has been surpassed. — *Walt Ducat and J. David Johnson*



University of Illinois students attended the **Chicago Chapter's** educational series on *Foundry Methods of Coremaking*. Shown left to right are Alan Cash, Martin Johanson, Richard Seilheimer, James Medici, Kurt Schiecke, Andrew Szady, Dale Lindermeier, Albert Smith, Frank Tiesner, Thomas Healy, Prof. Roy Schroeder, Guy Castino, Franklin Brumwell, Fred Sadowski, and John Kutz. — *Ed Burch*



Chicago Chapter's annual ladies' night party was held in February included dinner, a floor show and dancing. — *John C. Mulholland*

Chicago Chapter Education Series

■ Foundry methods of coremaking were discussed in a series of three meetings conducted in March.

A capacity audience of 248 attended the opening meeting to hear Elmer C. Zirzow, Werner G. Smith, Inc., Cleveland discuss *Why Four Methods of Coremaking?* He presented a general description of soil sand, air-setting, shell, and CO₂ methods of coremaking and the advantages and disadvantages of each.

Oil Sand Cores and *Air-Set Cores* were covered at the second session by R. H. Greenlee, Auto Specialties Mfg. Co., St. Joseph, Mich., and Frank Soderstrom, Continental Foundry & Machine Div., Blaw-Knox Co., East Chicago, Ind.

The final session was devoted to *Shell Cores* and *CO₂ Cores* featuring as speakers J. E. Stock, John Deere, Waterloo Tractor Works, Waterloo, Iowa, and George Nestor, National Malleable & Steel Castings Co., Cleveland. — *Ed Burch*

Piedmont Chapter

Completes Program

■ Details have been completed on the 1958-59 technical program. The Piedmont Chapter, newest member of AFS, holds its meetings every other month.

The program:

September—Casting Defects, Clyde A. Sanders, American Colloid Co., Skokie, Ill. Meeting at Charlotte, N.C.

November—Aluminum Casting Defects and Their Correction, D. L. LaVelle, Kaiser Aluminum & Chemical Sales, Inc., Chicago. Meeting at Richmond, Va.

January—Mechanization for the Small Foundry, C. V. Nass, Beardsley Piper Div., Pettibone Mulliken Corp., Chicago. Meeting at Greenville, S.C.

March—Shop Methods and Control of Ductile Iron Castings, T. W. Curry, Lynchburg Foundry Co., Lynchburg, Va. Meeting at Lynchburg, Va.

May—Cupola Operations, Ralph Carlson, American Cast Iron Pipe Co., Birmingham, Ala. Meeting at Greenboro, N.C.

Detroit Chapter

Atomic Development

■ Approximately 300 members of the Detroit Chapter and the Ontario Chapter attended a March meeting held in Windsor, Ont. The meeting designated at International and Management Night was sponsored by the Detroit Chapter with Canadian foundrymen invited to attend.

Walker L. Cisler, Detroit Edison Co., spoke on *The Effect of Atomic Development in the International Detroit-Windsor Area*. Cisler stated that the known reserves of nuclear fuels were at least 23 times greater than the known reserves of coal, gas, and oil. Uranium and coal samples were shown. A piece of anthracite coal weighing 3-1/4 lb produces 4-1/2 kilowatt hours of electrical energy. A similar amount of uranium will produce 12 million kilowatt hours of energy. — Edwin A. Swenson

Ontario Chapter

Molding and Melting

■ More than 200 foundrymen attended the March meeting to hear Harry Kessler, Sorbo Mat Process Engineers, St. Louis.

Kessler pointed out the advantages of good control over processes, raw materials, melting, and metallurgy, emphasizing that it is possible to evaluate certain procedures with simple formulae. He presented a set of figures applied to the charge make-up including steel, pig iron and other materials from which it is possible to calculate tensile strengths. Formulae were also given for riser dimensions, facing sand make-ups, and gate cores. — P. J. Provias



Mo-Kan Chapter

Good Brass Castings

■ Pouring of good brass castings was explained at the April meeting by Ray Cochran, R. Lavin & Sons, Inc. AFS Regional Vice-President R. W. Trimble attended and outlined affairs of the Society. — J. T. Schlanker

Timberline Chapter

Green Sand Molding

■ Recent developments in green sand molding practices were explained at the April meeting by William Adams, Eastern Clay Products Dept., International Minerals & Chemicals Corp., Chicago. — D. C. Card



Speaker Walker L. Cisler, Detroit Edison Co., receives set of cast iron book ends from Detroit Chapter Chairman C. W. Yaw, Sr., Cadillac Motor Car Div., GMC, Detroit. Cisler spoke to Detroit and Ontario Chapter members on the development of atomic development in the Detroit-Windsor area.

Southern California

Core Shooter Discussion

■ Core shooters were discussed at a recent meeting by William A. Geisler, Davenport Machine & Foundry Co., Davenport, Iowa. Core shooting, he explained, differs from core blowing by using air to push rather than blow sand into the core box.

Among the advantages listed were the use of wood core boxes, reduction of core box wear, simplified venting, use of stronger and heavier sands, use of resin bonded sands, and liners and seals are generally not needed.

Eastern New York

Epoxy Plastics

■ Epoxy resins were the subject of discussion at the March meeting. Mark Goodyear, Houghton Laboratories, Olean, N.Y., presented an illustrated lecture showing how epoxies were used at a Candian foundry.

Goodyear explained the durability of resins as pattern material. He pointed out that epoxies are not affected by moisture or temperatures up to 400 F. — Leonard C. Johnson

Northeastern Ohio

Organizational Building

■ *Building a Modern Foundry Organization* was explained at the April meeting by Edwin J. Walcher, American Steel Foundries, Chicago. He recommended that an organization chart be drawn to indicate the desired arrangement. Then an inventory made of individuals now filling the various positions.

Efforts should be directed to achieving pre-established goals but flexibility maintained to deal with future developments. — Edwin Bremer

Southern California Conducts Apprentice Contests

■ Winners of the Southern California local chapter apprentice contest were announced at the March meeting. Competition was held in the divisions of the Robert E. Kennedy Memorial Contest as well as contests for high school students.

Non-Ferrous Molding—1st, William Boatright, AiResearch Mfg. Co.; 2d, Loring Thomas, AiResearch Mfg. Co.; 3d, Ralph Leland, Alloy Aluminum Foundry.

Iron Molding—1st, Roger Teagarden, Southwest Foundries; 2d, Ray Hoppings, Jr., Hoppings Foundry Co.; 3d, Manuel Trillo, Dameron Alloy

Foundry.

Steel Molding—1st, Robert Garcia, Kay-Brunner Steel Co.; 2d, Eulalio Estrada, Kay-Brunner Steel Co.; 3d, Carlton Wilson, AiResearch Co.

Patternmaking, jobbers division—1st, Denzel Dana, Johnston Pump Co.; 2d, Per Petersen, K&L Pattern Co.; 3d, Gerald Celk, John Beuse Pattern.

Don Bosco High School Competition—1st, Bob Mattern; 2d, Carl Van Winkle; 3d, John Longano.

Santa Monica Trade School Competition—1st, Herb Schandler; 2d, Don Cook; 3d, Wendell Coen.



Don Bosco High School student winners shown with trophies awarded by Southern California Chapter. Left to right are John Longano, Carl Van Winkle, and Bob Mattern. In rear are Tony Tozzolino, Overton Foundry and Chris Della Rocca, Snyder Foundry Supply Co., chairman of molding competition.



Jim Oliva, Pattern Supply Co., chairman of the patternmaking competition, and Bob Hall, foundry instructor at Santa Monica Trade School inspect pattern. Hall is retiring after 20 years of service to the school and the local foundry industry.

Metropolitan Chapter

Foundry Mechanization

■ Mechanization in small foundries was discussed at the March meeting by Oscar Kastens, Newaygo Engineering Co. A movie showed numerous foundries with varying degrees of mechanization including sand handling, sand conditioning, centralized pouring and shakeout, and mechanized flask return.

The proposed Newark, N.J., smoke abatement ordinance was also discussed at the meeting. Chapter Chairman Howard E. Voit, Sterling Wheelbarrow Co., New York, presided. — C. H. Fetzner

Northern Illinois & Southern Wisconsin

Elects New Officers

■ Officers and Directors have been elected by the Northern Illinois & Southern Wisconsin Chapter.

Chairman—Harry V. Rossi, Ebaloy Foundries Corp., Rockford, Ill.

Vice-Chairman—John F. Carberry, Gunite Foundries Corp., Rockford, Ill.

Secretary—George Tamblin, Greenlee Bros & Co., Rockford, Ill.

Treasurer—William B. Sterna, Fairbanks, Morse & Co., Beloit, Wis.

Directors (Terms expire 1961)—H. M. Bacon, Beloit Foundry Co., Beloit, Wis.; Roy Ray, Fairbanks, Morse & Co., Beloit, Wis.; John Seeboth, A. P. Green Fire Brick Co., Beloit.

Rochester Chapter

Aluminum Casting Design

■ Rochester members at the March meeting heard George L. Moore, Aluminum Co. of America, outline the principles of *Designing Aluminum Castings for Production and Serviceability*.

Leon C. Kimpal, who recently retired after 46 years service with the Rochester Gas & Electric Co., was honored by the chapter. Kimpal formerly served as Chapter Chairman and had been active for many years in the chapter activities.—Thomas B. DeStefani

afs chapter meetings

MAY						
	S	M	T	W	T	F
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31				

MAY

Birmingham District . . May 9 . . Thomas Jefferson Hotel, Birmingham, Ala. . . *Panel Discussions: Maintenance:* B. Y.

Cooper, D. Little, A. White. *Molding:* E. C. Finch, A. S. Glidewell, J. Varnon, N. E. Pugh.

British Columbia . . May 23 . . Leon's, Vancouver, B. C. . . *Election of Officers.*

Canton District . . *No Meeting.**

Central Illinois . . May 5 . . Vonachen's Junction, Route 88 . . *Panel Discussion: Molding, Melting, Cleaning and Core-making.*

Central Indiana . . May 5 . . Athenaeum Turners, Indianapolis . . A. E. James, Haynes Stellite Co., Div. Union Carbide Corp., "Standardization & Compliance Programs in the Foundry."

Central Michigan . . *No Meeting.**

Central New York . . May 9 . . Hotel Onondaga, Syracuse, N. Y. . . A. Dorfmueller, Jr., Archer-Daniels-Midland Co., "Which Core Process."

Central Ohio . . May 12 . . Seneca Hotel, Columbus, Ohio . . R. Monsalvatge, National Management Association, "The Supervisor's Role in Human Relations."

Chesapeake . . *No Meeting.**

Chicago . . May 5 . . Chicago Bar Association, Chicago . . L. B. Knight, Lester B. Knight & Associates, Inc., "Automation in the Foundry."

Cincinnati District . . *No Meeting.**

Connecticut . . May 28 . . Shuttle Meadow Country Club, New Britain, Conn. . . H. F. Taylor, Massachusetts Institute of Technology.

Corn Belt . . May 9 . . Dempster Mill & Mfg. Co., Beatrice, Neb. . . H. H. Kessler, Sorbo-Mat Process Engineers, "Gating & Riser Design."

Detroit . . *No Meeting.**

Eastern Canada . . May 16 . . Sheraton-Mt. Royal Hotel, Montreal, Que. . . *Presentation of Winning Chapter Contest Paper and Business Meeting.*

Eastern New York . . May 13 . . Panetta's Restaurant, Menands, N. Y. . . *Ladies' Night.*

Metropolitan . . May 5 . . Essex House, Newark, N. J. . . *Round Table Discussion: "Casting Defects—Their Cause & Correction."*

Mexico . . May 12 . . Av. Chapultepec 412, Mexico D. F. Mexico . . R. O. Varela, Construcciones Industriales S. A., "The Making of Large Castings in Mexico."

Michiana . . *No Meeting.**

Mid-South . . May 9 . . Hotel Claridge, Memphis, Tenn. . . *Election of Officers.*

Mo-Kan . . *No Meeting.**

New England . . May 14 . . University Club, Boston . . E. Harlow, Draper Corp.

Northeastern Ohio . . May 8 . . Tudor Arms Hotel, Cleveland . . *Recognition Night.*

He's from Texas... was an instructor at Rice Institute, and a research engineer at U.S. Radiator

He pioneered the development of Sand Testing apparatus and Techniques

Harry DIETERT

AFS President

In 1940 he received the AFS Wm H. McFadden Gold Medal for promoting interest in foundry sand research & Control

IS AN AUTHORITY ON SAND CONTROL AND TESTING. HE HAS WRITTEN MANY PAPERS AND LECTURED NATIONALLY ON THE SUBJECT. SERVED ON AFS SAND RESEARCH COMMITTEE SINCE INCEPTION.

Personalities

Northern California . . May 9 . . Orinda Country Club . . *Ladies' Night* . . May 14 . . Spenger's, Berkeley, Calif. . . *Plant Tours:* H. C. Macauley Foundry Co., Berkeley Brass Foundry Co. and Pacific Steel Castings Co.

Northern Illinois & Southern Wisconsin . . May 24 . . Country Club, Beloit, Wis. . . *Picnic.*

Northwestern Pennsylvania . . May Meeting Advanced to June 2.

Ontario . . May 16 . . Royal Connaught Hotel, Hamilton, Ont. . . H. J. Hugh, Eureka Foundry & Mfg. Co., "Shell Molding."

Oregon . . May 21 . . Heathman Hotel, Portland, Ore. . . *Paper Presentation by Oregon State College Student Chapter.*

Philadelphia . . May 9 . . Engineers' Club, Philadelphia . . W. S. Thomas, Emmaus Foundry & Machine Co., Inc.,

"What the Customer Wants in His Castings."

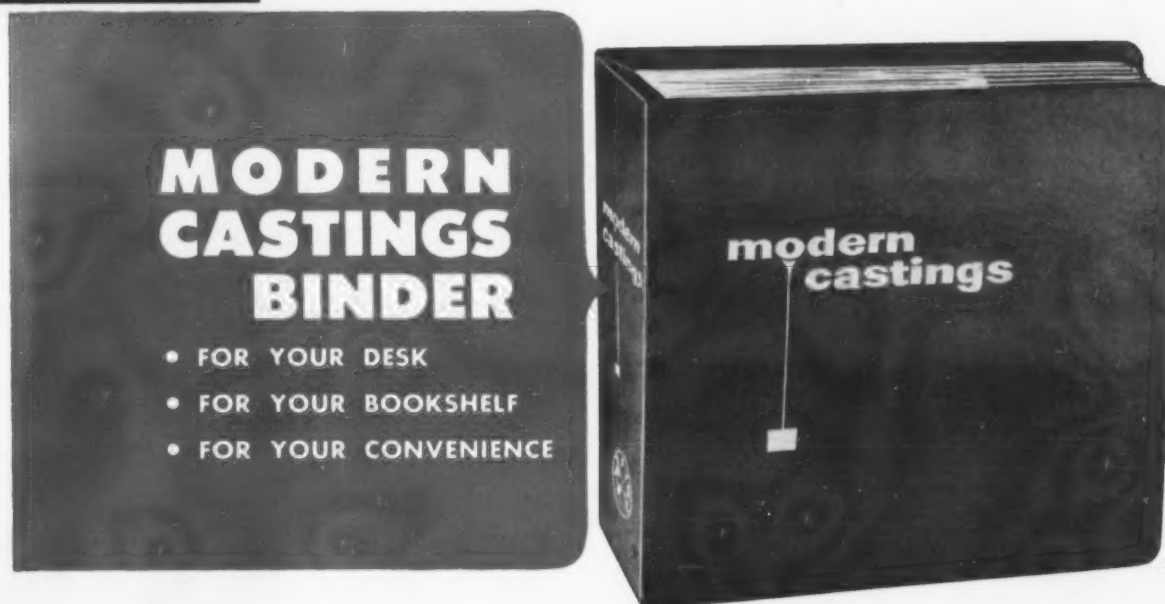
Piedmont . . May 2 . . Hotel Cleveland, Spartanburg, S.C. . . J. S. Schumacher, Hill & Griffith Co., "Fool-Proof Sand."

Pittsburgh . . May 26 . . Hotel Webster Hall, Pittsburgh, Pa. . . *Educational Meeting, "The Foundry Industry & eRelated Training at Trade School, High School & College Levels."*

Quad City . . May 19 . . Hotel Ft. Armstrong, Rock Island, Ill. . . H. Wood, Alabama By-Products Corp., "Coke and the Cuopla."

Rochester . . May 6 . . Hotel Seneca, Rochester, N.Y. . . *Election of Officers.*

Saginaw Valley . . May 1 . . Fischer's Hotel, Frankenmuth, Mich. . . R. W. Gardner, Dearborn Iron Foundry, Ford Motor Co., "Quality Control in the Foundry."



A FULL YEAR OF MODERN CASTINGS

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St. Louis District . . May 8 . . Edmond's Restaurant, St. Louis . . W. G. Gude, Penton Publishing Co., "The Future of the Foundry."

Southern California . . May 9 . . Rodger Young Auditorium, Los Angeles.

Tennessee . . May 23 . . Patten Hotel, Chattanooga, Tenn. . . C. N. Walker, Coca-Cola Co., "Public Relations Is Your Business." Management & Ladies Night.

Texas . . No Meeting.*

Timberline . . May 12 . . Oxford Hotel, Denver, Colo. . . H. H. Kessler, Sorbomat Engineers, "Gating & Rising."

Toledo . . No Meeting.*

Tri-State . . May 2 . . Halliday Inn, Oklahoma City, Okla. . . A. Dorfmueller, Jr., Archer-Daniels-Midland Co., "What Core Process."

Twin City . . May 13 . . Jax Restaurant, Minneapolis . . J. A. Westover, Westover Corp., "Practical Quality Control."

Utah . . No Meeting.*

Washington . . May 15 . . Engineers' Club, Seattle . . Panel.

Western Michigan . . May 5 . . Bill Stern's Muskegon, Mich. . . A. C. Mahonske, Semet-Solvay Div., Allied Chemical & Dye Corp., "Foundry Coke" and D. M. Anderson, Refractory Products Co., "Induction Melting of Non-Ferrous Metals."

Western New York . . May 1 . . Sheraton Hotel, Buffalo, N. Y. . . E. E. Braun, Central Foundry Div., GMC., "To Meet the Challenge."

Wisconsin . . May 9 . . Schroeder Hotel, Milwaukee . . C. A. Sanders, American Colloid Co., "Old & New Foundry Tools in Europe." Apprentices' and Old Timers' Night.

* Many Chapters have cancelled May meetings to avoid conflict with the Castings Congress & Foundry Show.

JUNE

Central Illinois . . June 14 . . Annual Clambake—Barbecue Stag.

Connecticut . . June 20 . . Restland Farms, Northford, Conn. . . Annual Outing.

Detroit . . June 28 . . Glen Oaks Country Club . . Golf Outing.

Eastern New York . . June 21 . . Willow Brook Inn, Schenectady, N. Y. . . Annual Outing.

New England . . June 13 . . Blue Hill Country Club . . Annual Outing.

Northeastern Ohio . . June 21 . . Golf Outing.

Northwestern Pennsylvania . . June 2 . . Amity Inn, Erie, Pa. . . E. J. Mapes, Pickands Mather & Co., "Taconite Ore" and Film, American Iron Frontier.

Saginaw Valley . . June 7 . . Potter's Lake . . Annual Outing.

Texas . . June 14 . . Fredonia Hotel, Nacogdoches, Texas. Joint Meeting with East Texas Section.

Western New York . . June 14 . . Sturm's Grove . . Annual Stag Outing.

LATE NEWS

Motion Pictures Added to AFS Show

■ Last minute changes in the program of the 62d AFS Castings Congress include the announcement that two motion picture theaters have been established in the exhibits halls, and a series of changes in the plant visitation plans.

Exhibitors at the 1958 AFS Show will screen their product application movies in two theaters set up in the halls of the Cleveland Public Auditorium. The theaters will be the NEO Theater located in the Auditorium, and the Buckeye Theater which will be in Upper Lakeside Hall. A schedule of the showings at the theaters appears later in this article.

The following changes have been made in the schedule of plant tours as announced in the April MODERN CASTINGS: Cleveland Standard Pattern Works will be open from 8 am to 3 pm; Ford Motor Co. will be open Monday from 10 am to 12 noon, and from 2 to 4 pm; Hill Acme Co. will not be open for inspection.

The schedule for the showings at the two motion picture theaters in the AFS Show is as follows:

The Buckeye Theatre

MONDAY, MAY 19

- 10:00 am "How to Follow Safety" by National Safety Council
- 11:00 am "Construction and Application of Air and Hydraulic Cylinders and Valves" by Galland-Henning Mfg. Co.
- 1:30 pm "Japanese Shell Molding Foundry" by Acme Resin Corp.
- 2:30 pm "The Matter of the Core" by The Osborn Mfg. Co.
- 3:30 pm "The Invisible Shield" by Claude B. Schneible Co.

TUESDAY, MAY 20

- 10:00 am "The Invisible Shield" by Claude B. Schneible Co.
- 11:00 am "Flexibility for Jobbing! Speed for Production!" "An Ace In The Hole" by Beardsley and Piper Div., Pettibone Mulliken Corp.
- 1:30 pm "Small Foundry Mechanization" by Newaygo Engi-

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→ for better castings at lower cost...

COLEMAN OVENS

The only complete line of Core and Mold Ovens made in every type for every method to fit YOUR requirements BEST!

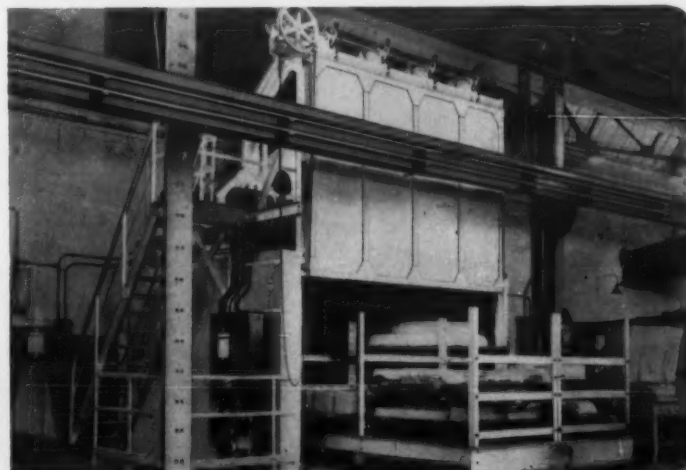
For better quality castings... for immediate savings in labor, materials and fuel, for consistently uniform baking of cores and molds at lower cost, install Coleman Ovens. Large and small foundries find Coleman Ovens are essential in producing castings to meet the most exacting specifications.

Performance records prove that Coleman Ovens may reduce overall core department costs by as much as 50%. Such savings mean increased profits and rapid amortization of the oven cost. Many Coleman Ovens have paid for themselves in less than a year!

Coleman Core and Mold Ovens provide exclusive features resulting from over 50 years of specialization in the design and construction of foundry ovens and over 10,000 installations in leading foundries. As builders of the world's only complete line of foundry ovens, we have no reason to recommend any but the oven best suited to your requirements.

Experienced Coleman Engineers are ready to help you with your foundry oven needs without obligation. Now, with production savings so important it will pay you to investigate the unusual advantages of Coleman Ovens.

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Coleman Car-Type Oven



Coleman Tower® Oven



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Coleman Dielectric Core Oven

A COMPLETE RANGE OF TYPES AND SIZES...

for every core baking and
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Tower Ovens • Horizontal Conveyor Ovens
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1825 COLUMBUS ROAD CLEVELAND 13, OHIO

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Circle No. 945, Page 7-8

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THE NEW DIETERT-DETROIT UNIVERSAL SAND STRENGTH MACHINE

Be sure to see it at the Foundry Show. It's the most advanced mold and core testing instrument available, and fits right in with today's improved foundry techniques and materials. The new No. 405 Universal Sand Strength Machine has much greater sensitivity, range and versatility than any instrument of its kind on the market. The unit features linear rate of loading on all strength tests. Ranges are as follows:

Compressive Strength for 2" dia. specimen.....	0 to 5.1 psi. (Sensitivity to 0.01 psi.) 0 to 51 psi. 0 to 510 psi. 0 to 620 psi.
Core Tensile.....	0 to 2480 psi.
Shell Tensile.....	0 to 400 psi.
Shear Strength for 2" dia. x 2" long specimen.....	0 to 400 psi. 0 to 360 lbs. 0 to 360 lbs.
Transverse Strength.....	0 to 100.0 oz./sq. in.
Shell Transverse.....	
Green Tensile Strength.....	

In addition to the strength tests (left), the new machine measures green deformation—(total), green deformation at any pre-selected load, deflection of core and shell specimens and records stress-strain curve on moldingsand.

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Send me complete information on the new No. 405 Universal Sand Strength Machine.

Name _____ Title _____
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Circle No. 946, Page 7-8

neering Co.

- 2:30 pm "Electric Furnace Fume Control" by Wheelabrator Corporation
3:30 pm "How Steel Abrasives Are Produced" by Wheelabrator Corporation

WEDNESDAY, MAY 21

- 11:00 am "Shell Processing Comes of Age" by Beardsley and Piper Div., Pettibone Mulliken Corp.
1:30 pm "Chaplets Are Quality Castings", "Chills Give Sound Castings" by Fanner Mfg. Co.
2:30 pm "The Matter of the Core" by The Osborn Mfg. Co.
3:30 pm "Small Foundry Mechanization" by Newaygo Engineering Co.

THURSDAY, MAY 22

- 10:00 am "What They Don't Know Can Hurt" by National Safety Council
11:00 am "Small Foundry Mechanization" by Newaygo Engineering Co.
1:30 pm "Electric Furnace Fume Control" by Wheelabrator Corp.
2:30 pm "Mechanization In Small Foundries" by Beardsley and Piper Div., Pettibone Mulliken Corp.
3:30 pm "Complete Foundry Automation With Utmost Flexibility" by American Automation Corp.

FRIDAY, MAY 23

- 10:00 am "Chaplets Are Quality Castings", "Chills Give Sound Castings" by Fanner Mfg. Co.
11:00 am "Construction and Application of Air and Hydraulic Cylinders and Valves" by Galland-Henning Mfg. Co.
1:30 pm "Japanese Shell Molding Foundry" by Acme Resin Corp.
2:30 pm "Chaplets Are Quality Castings", "Chills Give Sound Castings" by Fanner Mfg. Co.
3:30 pm "The Matter of the Core" by The Osborn Mfg. Co.

The NEO Theatre

MONDAY, MAY 19

- 10:00 am "Exhaust Hoods, Their Design and Application" by American Air Filter Co., Inc.
11:00 am "Air Control Technics" by Ross Operating Valve Co.
1:30 pm "New Welding Procedures"

**Produce More
Top Quality
Castings**

with
**Top Quality
FOUNDRY
MATERIALS**

**Use these Time-Tested
Products for Best Results**

SAND

Portage (Wis.) Silica
Century Molding
*Ottawa Blackhawk Silica
Muskegon Lake Sand
Tenn. & Ind. Molding
Utica Crude Silica
Green Lake & St. Marie Shell
*Zircon Sand, Flour and Wash
Berlin Core Sand
Red Flint Annealing & Packing
New Jersey Molding
Gallia Red Molding
Albany Molding

BONDING CLAYS

*Volclay, MX-80 (Granular)
*and Panther Creek Bentonite
*Goose Lake Fire Clay
*Grundite Bonding Clay

ABRASIVES

*Tru-Steel Steel Shot
Mallan' Steel Shot and Grit
*Mallebrasive Shot and Grit
*Certified Shot and Grit
*Blackhawk Sand Blast Sand
*Super-Titan Nozzles

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*Sultron Foundry Flux
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Circle No. 947, Page 7-8

by Eutectic Welding Alloys Corp.

- 2:30 pm *"The GREFCO Story"* by General Refractories Co.
3:30 pm *"The Green Drum"* by Vanadium Corporation of America

TUESDAY, MAY 20

- 10:00 am *"Production of Crude and Dried Sands"* by The American Silica Sand Co., Inc.
11:00 am *"The Air We Breathe"* by Mine Safety Appliances Co.
1:30 pm *"The Air We Breathe"* by Mine Safety Appliances Co.
2:30 pm *"Story of Volclay"* by American Colloid Co.
3:30 pm *"The Big Difference"* by Magnaflux Corp.

WEDNESDAY, MAY 21

- 11:00 am *"The ADM of Cores"* by Archer - Daniels - Midland Co.
1:30 pm *"New Welding Procedures"* by Eutectic Welding Alloys Corp.
2:30 pm *"Story of Volclay"* by American Colloid Co.
3:30 pm *"The Green Drum"* by Vanadium Corp. of America

THURSDAY, MAY 22

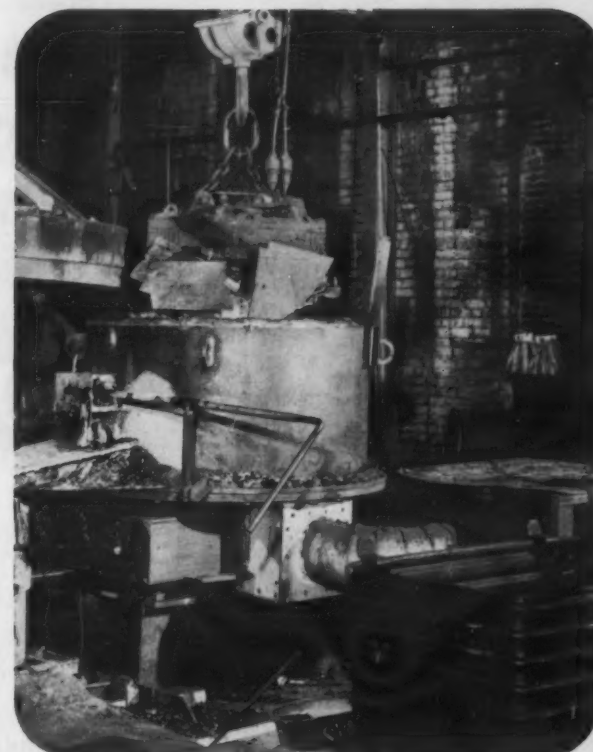
- 10:00 am *"Exhaust Hoods, Their Design and Application"* by American Air Filter Co.
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5 ways to make your foundry more efficient with OHIO MAGNETS



1 CHARGING FURNACE. One 36-inch Ohio Bolted Magnet charges six 375 KW furnaces giving 240 500-pound heats each 24 hours.



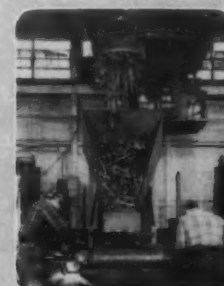
2 SCRAP HANDLING. All scrap is handled efficiently, economically with Ohio Magnet. Single 36-inch magnet replaces grapple, clamshell, bucket or lift truck.



3 SORTING. Castings are conveyed from Wheelabrator to hard-iron inspection. Ohio Magnet picks parts out of sorting bin.



4 UNLOADING ANNEALING FURNACE now takes one man 10 to 20 minutes with Ohio Magnet. Lift truck used to take 1 to 2 hours.



5 LOADING GRINDING HOPPER after conveying parts from inspection department. Same Ohio Magnet is used for operations shown in photos 3, 4 and 5.

Photos: Courtesy I-F Manufacturing Company, New Philadelphia, Ohio



CHESTER BLAND
President

Small foundry or large, magnetic materials handling points the way to higher productivity, higher efficiency. And with Ohio Magnets on the job you get high availability, too. That's because Ohio Magnets are built with that extra margin of safety that means long, service-free life. Yes, magnetic materials handling pays—especially with Ohio Magnets.

THE OHIO ELECTRIC MFG. CO.

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Circle No. 948, Page 7-8

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Completely New Foseco[®] DEGASER 400



DEGASER 400 being plunged into aluminum alloy melt. Test results confirm that DEGASER 400 can produce aluminum alloy melts of such low hydrogen content that even in the heaviest cast sections pinhole porosity due to absorbed gases is eliminated.

- Inexpensive
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- Very little fuming
- Completely eliminates gas
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Circle No. 949, Page 7-8

158 • modern castings

let's get personal

W. W. C. Ball . . . Taylor & Fenn Co., Windsor, Conn., formerly vice-president of the company, has been named president.

C. C. Schmidlin . . . vice-president, Midwest Pressure Casting Co., Normal, Ill., is also serving as sales manager for the firm.

A. L. Retis . . . has been promoted from secretary to vice-president and treasurer, Stanal Aluminum Castings Co., Inc., Chicago.

Vincent Delpont . . . director and treasurer, Penton Publishing Co., Ltd. Westminster, London, England, has been awarded the Meritorious Services Medal by the Institute of British Foundrymen. He was honored with an AFS Service Citation in 1957 for his service as AFS European representative to the International Committee of Foundry Technical Associations. He has held this position since 1926, serving as president of the committee in 1937, and treasurer since 1956.

R. S. Bradley . . . vice-president, A. P. Fire Brick Co., Mexico, Mo., has been elected president, American Ceramic Society. He has been with the company since 1925, and in charge of the Div. of Research and Engineering since 1949.

F. S. Claghorn . . . has been appointed vice-president, Foundry Div., Fletcher

Works, Inc., Philadelphia. He is a member, AFS Philadelphia Chapter.

W. H. Shinn . . . has been named assistant to the president, Gunitite Foundries Corp., Rockford, Ill. Other promotions include; H. F. Forbes, sales manager of industrial products, and S. A. Malthaner, director of engineering for all company products. The foundry is said to be one of only two in the United States producing gray iron, ductile iron, and steel castings under one roof.

Jack Scarbath . . . recently appointed treasurer, Philadelphia Steel Abrasive Co., Modena, Pa. Former All-American quarterback for the College All-Stars in 1953, he played professional football for four years until sidelined by an injury. In addition to his present position, he is now backfield coach at the University of South Carolina. He also holds a membership in the AFS Philadelphia Chapter.

W. D. Haentjens . . . former vice-president of Barrett, Haentjens & Co., Hazleton, Pa., is now president of the firm.

C. R. Spencer . . . has recently been appointed executive vice-president, Lynchburg Foundry Co., Lynchburg, Va.

D. V. Hamilton . . . Griffin Steel Foundries Ltd., St. Hyancinthe, Que-



V. Delpont



F. S. Claghorn



C. R. Spencer

bec, Canada, has been made vice-president and general manager for the company.

W. B. Nicholson . . . is now vice-president, gas products of Linde Co., Div. Union Carbide Corp., New York. He joined the company in 1935, and was appointed manager of development in 1956.

G. A. Tamblyn . . . is sales manager of the new industrial tractor shovel line being introduced by Yale Materials Handling Div., Yale & Towne Mfg. Co., Philadelphia. He has held executive positions in the bulk materials handling industry since 1940, and is a member, AFS Philadelphia Chapter.

E. W. Schenck . . . is the new secretary and treasurer, Grede Foundries, Inc., Milwaukee. He succeeds **R. L. Lee**, who has retired after more than 37 years of service with the firm.

H. M. Fisher . . . has joined the Akron, Ohio plant of the Biggs Foundry and Fabricating Co., subsidiary of Union Spring Co., New Kensington, Pa. He holds the position of vice-president in charge of engineering and production, coming from Firestone Tire and Rubber Co., Akron, Ohio.

Forbes Howard . . . is the new general sales manager for Ainsworth-Precision Castings Div., Harsco Corp., Detroit. He was formerly with United Carr Fastener Corp., Cambridge, Mass.

Michael Gladstone . . . has been named general manager of Alloy Precision Castings Co., Cleveland. **W. Poremba** is the new sales manager. **H. A. Stier . . .** Penn Rillton Co., New York, has been appointed vice-president of the firm. He was formerly sales manager.

F. A. Layne . . . Louthan Mfg. Co., East Liverpool, Ohio, has been promoted from sales to works manager.

B. L. Meredith . . . formerly with Federated Metals Div., American Smelting and Refining Co., South Plainfield, N. J., has left the company to become a manufacturers' agent in Baltimore, Md. He will represent companies engaged in ferrous and non-ferrous metalcasting, and screw machine products manufacturing.

D. G. Tucker . . . has recently been appointed sales representative for Nordberg Mfg. Co. His headquarters are at the Milwaukee plant. Tucker had been associated with the com-



Over 60 YEARS of service to Industry

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**UNITED STATES ELECTRICAL TOOLS
FINISH CASTINGS FASTER, CHEAPER**

NOW—when quality performance and money-saving are of utmost importance—when cost-minded executives demand exacting vigilance these tools fulfill every requirement.

The entire US line—for all industry—designed, engineered and built with the skill acquired in over 60 years is strictly for practical use. Foundries, large or small, no matter what capacity, constantly turn out more and better castings at lowest costs with US Electrical Tools. YOUR foundry, too, will profit!

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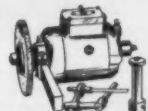
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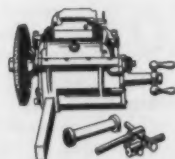
SWING FRAME GRINDER



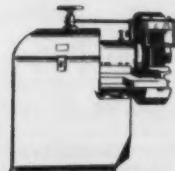
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AND BUFFER



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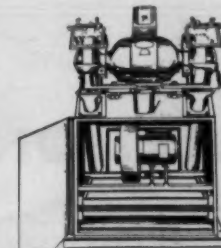
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May 19th thru 23rd, 1958

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The NEW Low Pressure Air SHELL CORE BLOWER

THE HARRISON 300-H

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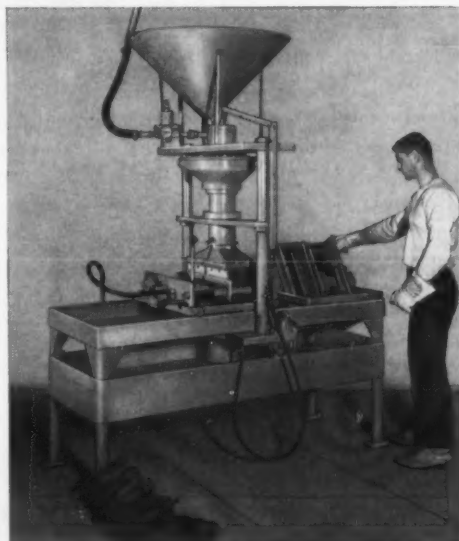
Harrison Patented Self-Feeder capacity — 200 lbs. Resin Coated Sand.

2-Station Shuttle Type for one or two operators.

Each Station has roll over action center pivoted.

Each Electric Heater Vise opened and closed by lever and cam action. (Air Cylinders extra.)

Air Regulator to select correct blowing pressure for different cores.



PRICE COMPLETE as illustrated
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In the 300-H we have met the need for a low cost manually operated shell core blower to complete our line of semi and full automatic Shell Core and Mold Machines. It has big output, controlled shell core quality for better castings and will handle different cores at each station. It's built for continuous operation and priced for the smallest foundry—or the big foundry with a need for high quality small core work. See it at the Cleveland Show, or write for Catalog 300-H.

HARRISON MACHINE CO.



Designers and Manufacturers
of
Shell Mold and Core Blowers
Manual, Semi or Full Automatic.

WESLEYVILLE • ERIE, PENNSYLVANIA

Circle No. 951, Page 7-8

160 • modern castings

pany since 1948; for the past two years, he has been assistant to the superintendent and production manager of the steel fabrication shop at the Milwaukee plant.

P. J. De Joy . . . formerly a partner, Joy-Lund Match Plate Shop, Minneapolis, now owns the company.

W. F. Watts . . . has been made factory manager, Refractories Div., Norton Co., Worcester, Mass. He has been with the company since 1935.

J. B. Peaslee . . . formerly manager, Manitowoc Grey Iron Foundry Inc., Manitowoc, Wis., recently became the owner.

T. E. Golden . . . president of Golden's Foundry & Machine Co., Columbus, Ga., is now also the firm's treasurer.

F. W. Burgie . . . is the new general sales manager, Doehler-Jarvis Div., National Lead Co., Toledo, Ohio. He has been with the company since joining Doehler-Jarvis Division in 1922 as a die designer.

R. E. Groethe . . . Jessop Steel Co., Washington, Pa., has been appointed to the staff of the metallurgical department. He was formerly employed by Corning Glass Works, Corning, N. Y.

Mario DeGennaro . . . has accepted the position of die shop manager, Precision Founders Inc., San Leandro, Calif. He formerly owned the Mars Mfg. Co., San Francisco, recently purchased by Precision Founders.

G. S. Finneman . . . has been promoted to general superintendent and secretary, National Iron Co., Duluth, Minn.

W. F. Schlick . . . Sterling Grinding Wheel Co., Tiffin, Ohio, has been promoted to general sales manager. He was formerly western regional sales manager for the company.

Rayburn Orr . . . has been appointed to the position of sales engineer in charge of development, Renfrow Foundry, Los Angeles.

Philip Hawkins . . . secretary-treasurer Texas Steel Co., Ft. Worth, Texas, since 1942, has been named president of the firm to succeed W. A. E. Woods, who has retired. Other new officers include **B. V. Thompson**, vice-president; **Thurman Killman**, vice-president; **M. C. Boisselier**, vice-president; **E. F. Laminack**, assistant

vice-president; **C. T. Ragland**, secretary; and **R. E. McHam**, treasurer. The company employs approximately 600, and operates a rolling mill and steel foundry.

W. H. Steinberg . . . is now technical consultant for Manhattan Rubber Div., Raybestos-Manhattan, Inc., Passaic, N. J. **L. S. Hilton** has succeeded him as sales manager of abrasive and diamond wheel departments.

J. F. B. Jackson . . . has been named managing director, A.P.V.—Paramount Ltd., Sussex, England. He joined the firm's board in 1954 after relinquishing his position as director, British



J. F. B. Jackson

Steel Castings Research Association. He has also joined the board of P.I. Castings (Altrincham) Ltd., Altrincham, Cheshire, England.

C. E. Peters . . . has recently been appointed plant manager, Beatty Machine and Mfg. Co., Hammond, Ind.

L. D. Wright . . . formerly foundry superintendent with National-United States Radiator Corp., New Castle, Pa., and past AFS National Director, retired from active service and is now serving as foundry consultant.

Ludwig Zengeler . . . has been named vice president, NCG Div., National Cylinder Gas Co., Chicago; and **W. T. Dellinger** has succeeded him as general superintendent of NCG industrial gas producing plants. Zengeler has been general superintendent since 1936, joining the organization in 1923. Dellinger has been with the company since 1955. The firm is said to be the third largest producer of industrial gases in the country.

E. R. Lawrence . . . formerly president, Pure Carbonic Co., New York Div., Air Reduction Sales Co., is now chairman of the firm's Pure Carbonic Div. **J. J. Lincoln, Jr.**, succeeds him as president. **J. H. Keeney** is now vice-

president, southern region, Air Reduction Sales Co., the position formerly held by Lincoln.

R. L. Williams . . . has been promoted to advertising manager, Gardner-Denver Co., Quincy, Ill. He was formerly assistant advertising manager for the company's industrial products division.

Jack Fitzgerald . . . is the new foundry sales representative for Frederic



J. Fitzgerald

B. Stevens, Inc., Detroit; he is a member, AFS Detroit Chapter.

W. S. Sherman, Jr. . . . is now president, Sherman Machine & Iron Works, Oklahoma City, Okla. He was formerly vice-president of the firm; and is a member, AFS Tri-State Chapter.

C. I. Brett . . . has been appointed foundry superintendent, Industrial Engineering Ltd., Vancouver, B. C. He will supervise production of sand-castings for aluminum power saws.

H. C. Snyder . . . has been made field representative for the midwestern regional group, American Die Casting Institute. He recently retired from Stewart Die Casting Div., Stewart-Warner Corp., Chicago, having served 38 years with the firm.

G. L. Hemmerly . . . is the new purchasing agent, Mathews Conveyor Co., Ellwood City, Pa. He has been with the company since 1935.

J. R. Greaves . . . now holds the position of sales representative, Joseph Dixon Crucible Co., Jersey City, N. J. His headquarters are in Los Angeles.

W. N. Kiely . . . has been promoted to senior field sales engineer in the midwestern area, NRC Equipment Corp., Newton Highlands, Mass.

D. N. Babb . . . has been appointed safety administrator, Electro Metallurgical Co., Div., Union Carbide



Ajax Lo-Veyor combination scalping screen and conveyor used in conjunction with sand reclamation system in new automotive foundry.

Take a trip through modern or modernized foundries and you will see how foundrymen are using Ajax Lo-Veyors to shake out high non-productive sand handling costs

Foundry profits are based on tonnage of castings, not tonnage of sand. It is a fact that America's newest foundries are being equipped with Ajax Lo-Veyors from beginning to end.

Today, one of the surest and most economical ways to make substantial savings is to cut sand handling costs. Ajax Lo-Veyors not only convey but separate and screen foundry sand, tramp iron and core wires. Ajax Lo-Veyors are made in a wide range of lengths, widths and capacities to fit every condition. They pay for themselves over and over again in captive and custom foundries, and case histories prove it. Write now for Ajax Lo-Veyor Bulletin 39.

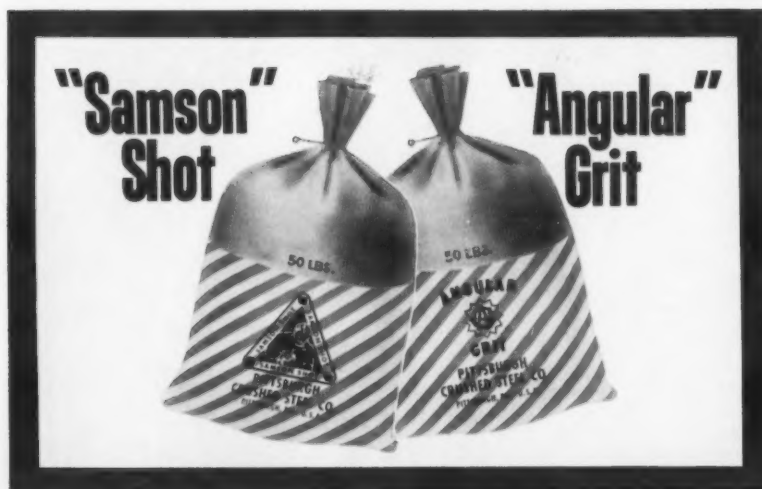
Ajax Lo-Veyors are perfectly simple and simply perfect for foundry conditions. Elimination of exposed bearings reduces maintenance costs particularly under foundry conditions where abrasive sand is constantly encountered. Drive unit is completely enclosed and operates in oil. Take advantage of Ajax specialized but broad experience in designing and building vibrating conveyors for foundry use.



AJAX FLEXIBLE COUPLING CO. INC.
Representatives in Principal Cities
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Circle No. 952, Page 7-8

May 1958 • 161



better chilled iron abrasives ...and why

We have specialized in the manufacture of metal abrasives since 1888. We have "grown up" with their expanding use. Such long contact with their production and use has given us unequalled know-how and experience in their manufacture.

A continuous program of research for the improvement of metal abrasives has been carried on with one of America's foremost metals research organizations since 1937.

We employ the most modern techniques in melting and processing to produce metal abrasives to exacting standards of chemistry, hardness, toughness and uniformity of these elements from one lot to another. It is more than significant that the two largest manufacturers of blast-cleaning equipment in the world sell and recommend Samson Shot and Angular Grit for best results in their equipment.



LEADERS in development of PREMIUM-TYPE ABRASIVES

The two best known names in premium abrasives were developments of two of our subsidiaries. MALLEABRASIVE, the first malleablized type of metal abrasive ever produced, set the pace for development of all other makes of premium abrasives. TRU-STEEL Shot was the first high-carbon all steel shot produced to meet demand for this specialized type of abrasive.

One of these products may do your blast-cleaning job better, and at lower cost. Write us for full information.

PITTSBURGH CRUSHED STEEL CO.

Arsenal Sta., Pittsburgh 1, Pa.

Subsidiaries: - - -

The Globe Steel Abrasive Co., Mansfield, O. (Malleabrasive)
Steel Shot Producers, Inc., Arsenal Sta., Pittsburgh (Tru-Steel)

Corp., New York. He became supervisor of safety for the company's plant in Alloy, W. Va., in 1955; and directed a safety program which made 1957 the safest year in the history of the plant.

T. E. Sheehan . . . has recently been appointed factory sales representative, Permanent Mold Die Co., Hazel Park, Mich. He will specialize in die casting dies, permanent molds and casting equipment. **Frank DeBuigne** has also joined the staff of the organization to head activities in the special machine tool field.

W. R. Carlson . . . is now Press Div. district sales manager in the New York area, E. W. Bliss Co., New York. He joined the company in 1947.

Frank Barnes . . . was recently made sales representative, Debevoise-Anderson Co., Philadelphia. He was formerly purchasing agent for Krupp Mfg. Co., Quakertown, Pa., and is a member AFS Philadelphia Chapter.

A. A. Behling . . . is the controller, Albion Malleable Iron Co., Albion, Mich. He is a certified public accountant, and was previously controller, Hudson Motor Div., American Motors Corp., Detroit.

F. P. Veach . . . is now sales representative for the Pekay Machine & Engineering Co., Chicago. He was formerly with Hydro-blast Corp., Franklin Park, Ill.

E. X. Enderlein . . . of H. G. Enderlein Co., is now vice-president and treasurer of the firm. He holds a membership, AFS Philadelphia Chapter.

J. A. Westover . . . formerly vice-president, Westover Corp., Milwaukee is now treasurer of the organization. He is a member, AFS Wisconsin Chapter.

Charles Anderson . . . formerly a partner, Wester Land Roller Co., Hastings, Neb., is the company's new president.

Frank Emmons, previously foundry superintendent, has been promoted to secretary-treasurer. Both are members, AFS Corn Belt Chapter.

W. S. Nadler . . . Nadler Foundry & Machine Co., Plaquemine, La., has been promoted to second vice-president of the firm.

R. F. Heiden . . . has been promoted from treasurer, Galva Foundry Co., Galva, Ill., to vice-president of the

firm. **H. L. Marlatt**, formerly assistant controller, is now the treasurer. Both are members, AFS Central Illinois Chapter.

O. McIntyre . . . a member, AFS Ontario Chapter, is the new vice-president, Canadian Grinding Wheel Co. Ltd., Hamilton, Ontario, Canada.

T. S. Pacer . . . has been elected executive vice-president, Illinois Gear & Machine Co., Chicago. Employed by the company for 25 years, he was formerly vice-president.

K. H. Meyer . . . director of engineering, C. B. Hunt & Son, Inc., Salem, Ohio, has been elected vice-president. He earned his Master of Science in Mechanical Engineering from Case Institute of Technology, Cleveland, in 1950; and was named director of engineering for the firm in 1957.

M. H. Davison . . . has recently been appointed development engineer for the applied research and development laboratory, Foundry Dept., General Electric Co. He joined the company in 1955.

David Coman . . . has been made president, Big Four Foundry Co., Tulsa, Okla. He was formerly pattern maker for the organization, and holds a membership, AFS Tri-State Chapter.

J. P. Singleton . . . formerly plant manager, Central Foundry Co., Holt, Ala., is now vice-president. He is a member, AFS Birmingham Chapter.

H. A. Beyer, Jr. . . . is now vice-president in charge of sales and a director, DeVlieg Machine Co., Detroit.



"But your temperature is normal."

pouring off the heat

equipment comment

The following is a comment from a metalcastings equipment builder that arrived too late for inclusion in the recent article "Equipment Manufacturers Reply to the Question: Does Foundry Equipment Meet Foundry Needs?"

■ We feel as foundry equipment builders it is our constant responsibility to improve the design of our product day by day, month by month and year by year. However, as builders of heavy equipment it must be recognized that the number of units installed in any given year are but a small percentage of the total units in operation, so that these improvements in design are only enjoyed by a small percentage at any given time.

In other words, with the life of the equipment some 25 to 30 years and some 1500 units in operation an average supply of 25 units a year would only cover 2% of the total users with improved designs in any given year. On the other hand, good service in the way of technical engineers and in the way of maintenance by prompt supply of spare parts would cover over 90% of the users of our equipment.

On this basis we are daily putting more emphasis on streamlining our abilities to supply spare parts and in emergency break-downs attempting to have the part or parts available within a day's notice. Shut-down time is, of course, very expensive to the foundry operator and although some parts can not be stocked and of necessity require a longer time, every day and hour of improved delivery will be of extreme help to the foundry operators.

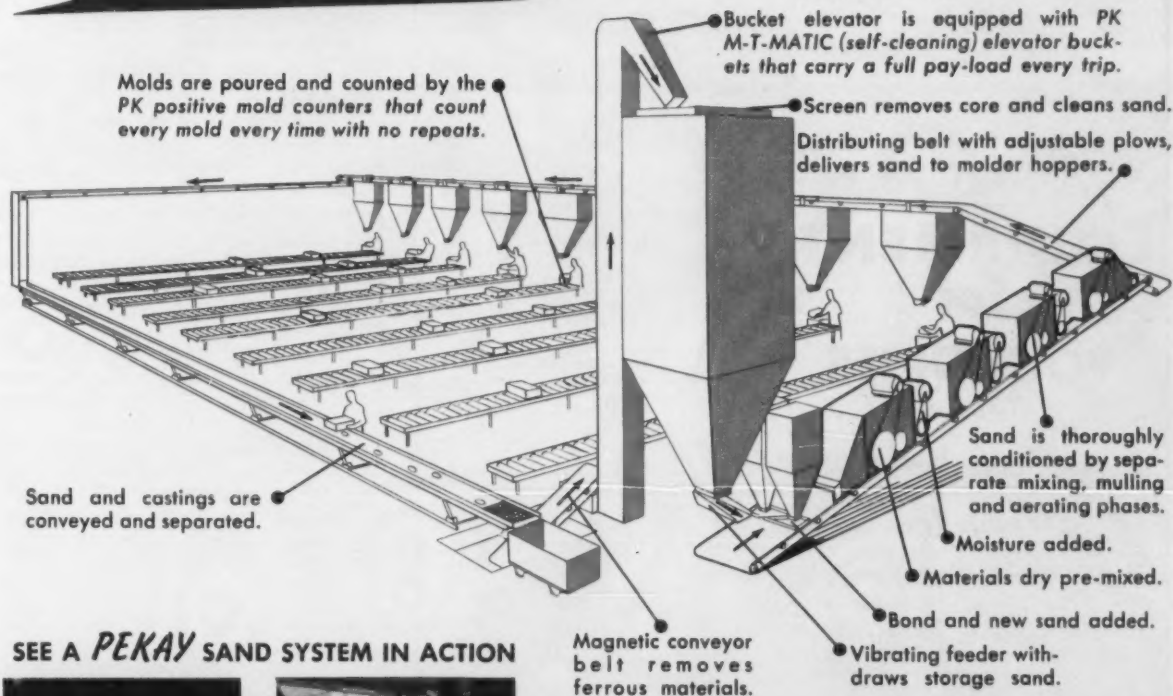
In addition to this we are in the process of setting up a servicing contract to make available field engineers to all our users on an annual, semi-annual or quarterly basis. The purpose of the service engineers' visits are to assist in adjusting the operating equipments and advise the users on wearing parts. The visits of these engineers, we feel, will be an extreme advantage in preventive maintenance and assistance in the overall streamlining towards the prompt supply of parts to eliminate unnecessary periods of costly shut-down."

NAME WITHHELD

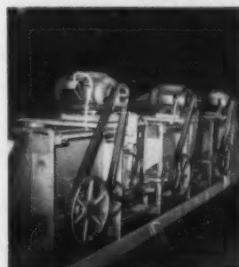
Continued on page 164

NOW! A COMPLETE SIMPLE AND EFFICIENT SAND SYSTEM every Foundry can afford!

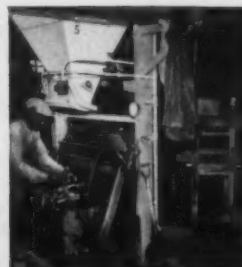
PLAN FOR THE FUTURE:
INCREASE PRODUCTION AND
LOWER UNIT COST WITH PEKAY
ADVANCED FOUNDRY EQUIPMENT.



SEE A PEKAY SAND SYSTEM IN ACTION



The dependable Pekay Mixer-Mullers have been in operation since 1949 without a single breakdown effecting production stoppage.



Molders Hoppers are coated on inside to prevent scaling and rusting. Molder gates are ball-bearing mounted and air-operated with hand lever in case of air cylinder failure.

BUY THE BEST FOR LESS

HERE'S WHY A

PEKAY

SAND SYSTEM

WILL PAY FOR

ITSELF IN ONE YEAR.

- Less equipment to buy.
- Less equipment to maintain.
- Less horsepower required.
- Less manpower required.
- One small pit excavation.
- One bucket elevator.
- Molders Hoppers always full.

PEKAY MACHINE & ENGINEERING CO. INC.

868 N. SANGAMON STREET

CHICAGO 22, ILLINOIS

SEE OUR DISPLAY AT THE FOUNDRY SHOW BOOTH NO. 1718-1720

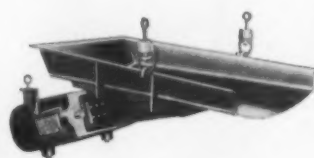
FEATURING:

- A PEKAY SAND SYSTEM WITHOUT CONVENTIONAL ELEVATORS.

- PEKAY COOLERATOR.

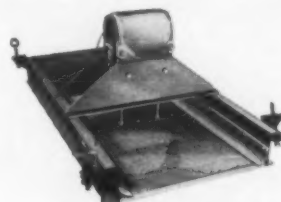
- PEKAY M-T-MATIC BUCKETS—BELT AND CHAIN MOUNTED.

Specialists in foundry sand conditioning and handling, slurry systems, engineering and equipment



**VIBRATORY
FEEDERS**

Controlled feeding of bulk materials — from pounds to hundreds of tons per hour.



**VIBRATING
SCREENS**

For screening, sizing, scalping, separating, etc. 5 different types. Electromagnetic, mechanical.

SYNTRON EQUIPMENT for FOUNDRIES

... designed for

Higher production rates

Longer trouble-free service

Lower maintenance costs

SYNTRON Equipment provides an efficient, dependable answer to most of your bulk materials handling problems. Backed by more than one third of a century in equipment manufacturing and application know-how.

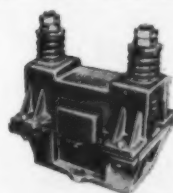
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Equipment of proven
dependable Quality



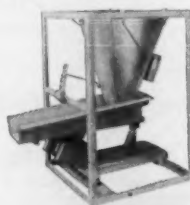
**SCREENING
FEEDERS**

For sizing, dewatering, dedusting, etc. Feed and screen in one operation. Screen up to 3" material size.



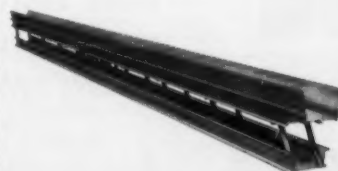
**BIN
VIBRATORS**

Assure positive flow of stubborn materials from bins, hoppers and chutes.



**DRY FEEDER
MACHINES**

Complete units for the controlled feeding of dry, bulk materials.



**SHAKER
CONVEYORS**

For conveying, preheating, drying, cooling or as picking table. Wide range of sizes.

Write for a SYNTRON Equipment catalog — FREE

SYNTRON COMPANY

545 Lexington Avenue

Homer City, Penna.

Circle No. 955, Page 7-8

Continued from page 163

home run for herb

■ I would appreciate 30 reprints of Herbert J. Weber's column "Would You Trust Your Life To A Sign" which appeared in the March issue. I think this is on wonderful article and would like copies for each one of our maintenance employees.

CHARLES F. SEELBACH, JR.
Forest City Foundries Co.
Cleveland

antic semantics

■ A recent editorial in your journal, written by Harry W. Dietert, deplored the use of the word "defect" in describing castings which were unacceptable to customers because of certain inherent shortcomings. In trying to avoid the use of this word "defect" one can become involved in some rather strenuous semantics.

I couldn't help but be amused by the title of the talk presented before the Philadelphia Chapter of the AFS in February: "Rectification of Casting Deficiencies." Could be that the speaker was talking about the "Elimination of Discontinuities in the Cast Matrix" or "Remedial Technology for Internal Discrepancies."

Why not be boldly frank and admit the talk was really about "Curing Casting Defects"?

Signed:
WALTER GOTMER

Iron and Steel Castings Shipments Down 9% in '57

■ Gray iron shipments for 1957 totaled 12,665,000 tons in 1957; malleable iron shipments were 863,000 tons; steel castings shipments totaled 1,766,000 tons.

The National Foundry Association, Chicago, in reporting these figures stated that each total is nine per cent less than in 1956.

Unfilled orders for gray iron castings on December 31, 1957 stood at 676,000 tons; unfilled orders for malleable castings totaled 75,000 tons; unfilled orders for steel castings totaled 327,000 tons. The backlogs were not as large as were reported in 1956.

MORE FACTS on all products, literature, and services shown in the advertisements and listed in Products & Processes and in For the Asking can be obtained by using the handy Reader Service cards, pages 7-8.

100 lbs.
ALUMINUM

in 12 minutes

OIL USED : 7/10 gal.

100 lbs.
BRASS

in 20 minutes

OIL USED : 1.2 gal.

see
**REVECON
furnaces**

IN OPERATION AT

Cleveland

AFS CONVENTION

Booths 1727 - 1729

Upper Lakeside Hall

MAY 19-23

See ... perfect control of metal and temperature. See ... metal loss under 2% for all metals. See ... why no crucibles are needed. Furnace sizes; 50 lbs. to 5,000 lbs. per heat.

**PERMANENT MOLD
CASTERS:**

See the Reverbale Dip-Out Furnaces for Aluminum and Brass.



INTERNATIONAL Foundry Supply Co.
P.O. Box 1053 Reading, Pa. Phone: FR 6-0794

Canadian: Drew Brown Ltd.
Representative: 5410 Ferrier St., Montreal 9
Circle No. 956, Page 7-8

Boston to be Site of 61st A.S.T.M. Annual Meeting

■ The week of June 22-27 will see the largest gathering of American Society for Testing Materials members in the history of the organization for the 61st Annual Meeting at Boston. Eight technical sessions, 11 symposiums, and over 800 committee meetings will highlight the meeting.

The tremendous need for authentic information in this technical age has stimulated several symposiums dealing with basic research and the furtherance of science. These symposiums will include materials research frontiers, basic mechanics of fatigue and radiation effects on materials.

New England industry will find pertinence in textile sessions, and symposium on paper and paper products and radioactivity in industrial water and industrial waste water.

Metalcasting industry personnel interested in high temperature properties of metals will appreciate these sessions: "The Creep Properties of Three Low-Shrinkage, Copper-Base Casting Alloys," W. F. Simmons and J. G. Kura, Battelle Memorial Institute, Columbus, Ohio; and "Mechanical and Physical Properties of Three Low-Shrinkage Copper-Base Casting Alloys," J. G. Kura, Battelle Memorial Institute, and R. M. Lang, Douglas Aircraft Co., Santa Monica, Calif.

The ferrous metals session will include; "Stress-Rupture and Creep Properties of Malleable Iron at Elevated Temperatures," L. C. Marshall and G. F. Sommer, Link-Belt Co., Chicago.

In conjunction with the Annual Meeting, the 13th Exhibit of Testing and Scientific Apparatus and Laboratory Supplies will be held. Over 60 exhibitors will display.

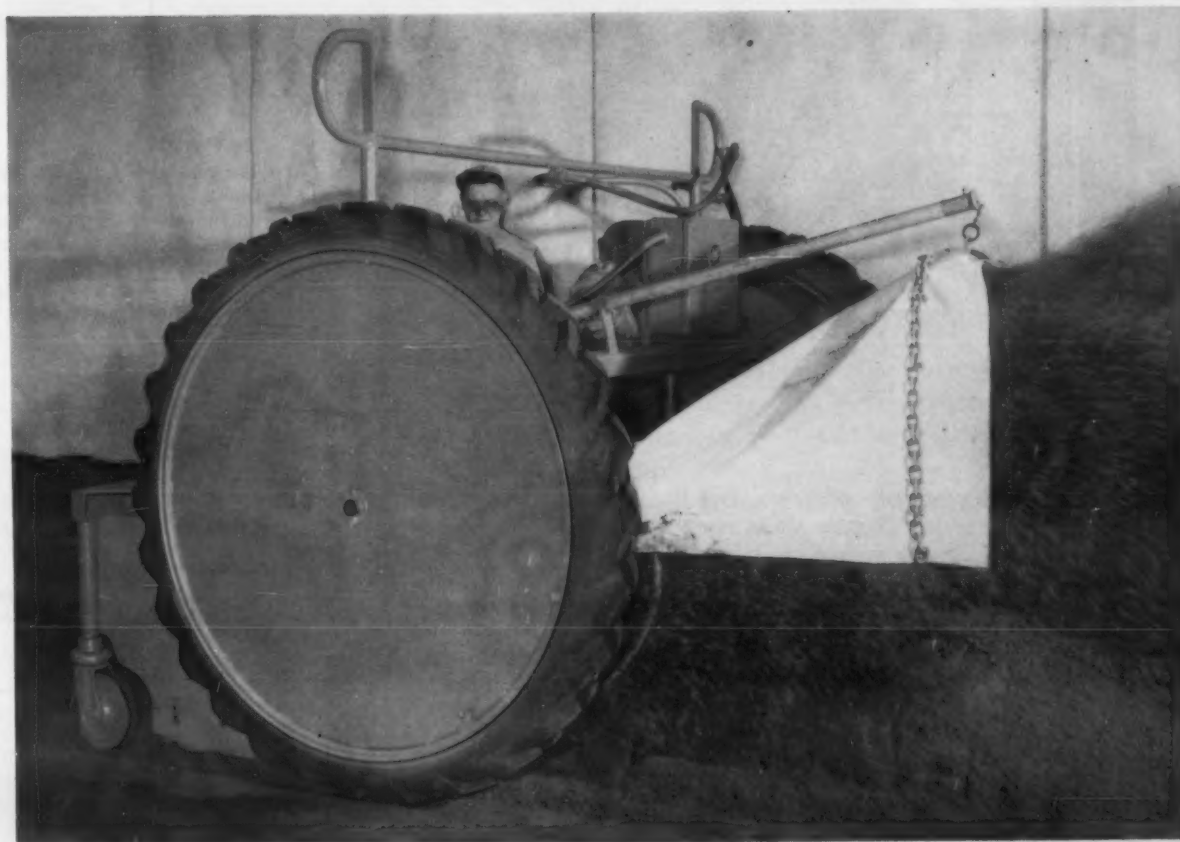
An additional exhibit will feature industrial photographs of metallographic micrographs. This exhibit and competition is expected to attract entries from the nation's leading industrial photographers.

Government to Give Machine Tools to Schools

■ A large store of machine tools are to be given to the nation's junior high schools, high schools, technical schools, colleges and universities by the United States Department of Commerce. Lathes, milling, grinding and drilling machines, and related equipment, about 13,000 pieces in all, have become excess to government requirements during the past 12 months.

■ For additional information, circle No. G, page 7, 8.

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MOULDERS like The New Moulders' Friend sand conditioner, because the blending action of the rotary wire brush thoroughly mixes and aerates the sand, making it easier to put up more and better molds.

NIGHT CREWS like it, because it eliminates much manual labor and does a better job of conditioning the sand. With this completely self-propelled machine one man can condition more than two tons of sand per minute.

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Three other handy sizes, 2.25 and 9.0 gram cartridges, plus a 108.0 gram charge in cup form, offer any combination of weights for introducing any percentage of lithium in the melt.

The 4.50 gram cartridge represents 0.010 lbs. of lithium rod. It will refine 200 lbs. of copper or copper-base alloy. All oxygen is removed, fluidity increased, pouring temperature often lowered, oxide and slag inclusions reduced, grain refined, and gas cavities eliminated—with no change in conventional melting and casting processes.

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Circle No. 958, Page 7-8

foundry trade news

Beloit Iron Works . . Beloit, Wis., formed a new Foundry and Machine Division and appointed Bond and Den Uyl Assoc. of Detroit to represent the new division in Michigan, Indiana and Northern Ohio. The new division is said to be the largest facility of its kind in the middle west. It is said to include a completely mechanized foundry for ductile iron, cast-iron, semi-steel, bronze and aluminum castings ranging from 5 lb to 40 tons.

Society of Die Casting Engineers, Inc. . . has elected Thomas J. Bridgeman, Latrobe Steel Co., to the post of program chairman for 1958. In this post Mr. Bridgeman will plan the educational program of the group for the coming year.

The Materials Handling Institute, Inc. . . reports that the dollar volume of

incoming orders booked in January was 93.07 using 1954 as an index of 100. Industry leaders, they state, point out that while business is off in comparison to recent record years, the materials handling industry is more than holding its own. They point to the fact that many industries are tackling the important task of reducing handling costs and state that companies who put their handling systems in better order will be in a more competitive position to increase their profit potentialities in leaner days.

The Foundation For Management Research . . states many more foundries will be using commercial financing to expand their production and sales. Older and larger manufacturers have been using this system during their growing years but today's difficulty lies in the younger companies not



Attention-getter for Sivyer Steel Casting Co., Milwaukee, is this display at Milwaukee's Mitchell Field airline terminal. Display is designed to attract attention of heavy traffic of businessmen passing through the terminal.

knowing how commercial financing operates.

Theodore H. Silbert, board chairman of Commercial Finance Companies of New York and president of Standard Financial Corp. has made a study entitled "Who Uses Commercial Financing—and Why?". Free copies are available by circling A, Reader Service Card., pp. 7-8. The study indicates how financing differs from bank borrowing and details of casts of various forms are discussed with examples in the free booklet.

American Die Casting Institute . . secretary David Laine attended the Raw Materials Subcommittee of the House Small Business Committee hearing, headed by Rep. Sidney R. Yates (Dem., Ill.). Mr. Laine stated that preferential prices for molten aluminum in the contracts between Reynolds Metals Co., Ford and General Motors Corp. were destroying the ability of the custom die casting industry to compete for an equitable share of its principal market—the cast aluminum automotive components. He stated that automobile manufacturers have installed captive die casting facilities making it necessary for the custom die casters to compete, not only with each other, but with their customer's divisions. It is Laine's contention that the totally unfair purchasing policies and marketing practices which have resulted from the "hot metal" contracts may decimate the custom die casting industry by destroying its ability to compete.

He outlined a rise in the aluminum die casting content of automobiles from an average of 31 lb to 200-275 lb per car if experimental aluminum die castings produced by custom die casters are adopted. This would mean an increase of 1 to 1-1/4 billion lb of aluminum for die cast automotive parts and, despite the present imbalance of aluminum, would make the need for further expansion of production capacity a matter of urgency within the next five years.

National Malleable and Steel Castings Co. . . Cleveland, announced at its recent annual meeting the establishment of a new plan for dividing sales and plant operations into two major line groups. A central staff will provide management services for the corporation.

Stowell C. Wasson, corporate vice president, will be responsible for services including metallurgical research and similar services. He is a founder and past president of the Foundry Educational Foundation.

William H. Moriarty, vice presi-

dent, will be the chief executive officer of the newly-formed Railway and Mine Division. Moriarty joined the company in 1919, is a former president of the Malleable Founders' Society and chairman of the Malleable Research Foundation.

Electro Refractories & Abrasives Corp. . . Buffalo, N. Y. has appointed Strong, Carlisle & Hammond, one of Cleveland's largest industrial supply houses, as their crucible and furnace refractories distributor within a 125-mile radius of Cleveland.

Allis-Chalmers Mfg. Co. . . began a 15-month safety program January, 1958, based on the theme "Knowing's Not Enough". Knowing such programs in industry are getting tougher to promote because of employee awareness of safety, R. S. Stevenson, president, stresses the value of *practicing* safety at work and at home. The "all stops out" campaign will include meetings held by key personnel in shop and office to define and explain the program and progressive results.

Caution is the watchword and is emphasized by the use of yellow caution flags displayed on supervisory employee desks as a constant reminder to slow down and think when confronted by any one or all four of the IMPS—Improvising, Impatience, Impulsiveness and Impunity.

The Vacuum Equipment Division of F. J. Stokes Corp. . . Philadelphia, announces the Canadian Dept. of Mines and Technical Surveys has placed a contract covering a 500-lb capacity vacuum stream degassing system to be installed at the Physical Metallurgy Div., Mines Branch in Ottawa. The equipment will be utilized to obtain information on the effect of vacuum stream degassing on reducing the gas content and other impurities in steel.

Shallway International Corp. . . of Palo Alto, Calif. and Greeley, England, announced the introduction of America's blastcrete cupola lining and patching gun to foundries in Europe, Asia and Latin America. **Blastcrete Equipment Co.**, Los Angeles, builds the refractory gun which will be given world-wide distribution by Shallway International.

Extension of the Trade Agreements Act . . (generally known as the Reciprocal Trade Agreements Statute) for a period of not less than five years, was urged in testimony given by W. Blackie, executive vice president, Caterpillar Tractor Co., before



This shows a line of stationary, gravity type Mold Dumps, one in action. In most cases one man can handle the dumping for the entire foundry.

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That's why foundrymen who use NOMAD EQUIPMENT talk about increased production, profit-making efficiency and all the other advantages they get.

NOMAD MOLD DUMPS SAVE ON MANPOWER!

After molds are dumped, NOMAD Mold Dumps enable one operator to separate sand and castings from roller-equipped bottom boards or pallets, *quickly and easily*. The empty boards or pallets are automatically returned by gravity on the lower track of Nomad's Double Level Conveyor to the molding end of the line. At this point Pallet Raisers elevate the bottom boards or pallets to the top track where they are ready for the next molds.

Whether you choose a stationary dump to serve a single line or one movable dump which rides on transfer track to serve several lines, depends upon *your* operation. In either case, NOMAD Mold Dumps feature effortless operation, fast dumping and sturdy construction. They handle a wide range of mold sizes.



Empty Pallet about to return onto lower return track.

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the House Ways and Means Committee, Washington, D. C. He recommended expansion of the negotiating authority of the President of the United States, in order to strengthen this nation's position in collective international bargaining. World-wide sales ranged from 13 million dollars in 1932 to 650 million dollars in 1957, the most significant aspect being derived from foreign business increase. Despite a rapid business decline in 1957, Caterpillar's export business exceeded 50 per cent, an increase of nine per cent, while domestic fell 13 per cent. Forty per cent of their employees would not have been needed

without this business, and the effect would have been felt by their 5,400 steel suppliers.

"Jobs of millions of Americans are protected not by tariffs designed to obstruct the inflow of foreign goods," Mr. Blackie said, "but by the ability of companies like ours to export. If we are able to help our country by helping ourselves, we need more opportunity to export, not less."

Oberdorfer Foundries, Inc. . . held a two-day sales meeting attended by representatives covering 19 states. The program was conducted by Raymond Purcell, vice president of sales,

and included a review of 1957 sales and an analysis of trends in the casting fields by area and type of industry. Kenneth A. Digney, president, covered Oberdorfer's investment in research and new equipment to increase production efficiency and improve competitive position. He stated the company earned a fine reputation for being specialists in complicated castings.

Frank Kidney, vice president and general manager of Oswego Castings Corp., Oberdorfer subsidiary in the permanent mold and die casting field, spoke on their operations which had improved 50 per cent over 1956.

Society of Aircraft Materials and Process Engineers . . Chairman B. Silverman and **The Magnesium Association** president, P. B. Craighead, announced a West Coast Symposium on magnesium applications in aircraft and missiles. The two-day meeting will be held June 4-5 at the Institute of Aeronautical Sciences Building, Los Angeles. The correlated program will make possible a much more comprehensive presentation than either might develop individually. Programming calls for the first day's papers being confined to technology and process control; and the second day's to papers prepared by aircraft personnel responsible for the incorporation of magnesium in aircraft and missiles. Jerry Singleton, executive secretary of The Magnesium Association, said "Key technical men from major magnesium fabricating plants and foundries, as well as representatives from Dow Chemical Co., and Magnesium Elektron Ltd., England, are preparing papers for the Symposium."

The Cast Bronze Bearing Institute . . was formed March 6 by producers of finish machined cast bronze bearings. Purpose of the Institute is to promote the use of cast bronze bearings and bushings through research, development, education and promotion. Founding firms have subscribed \$1000 each to start the C.B.B.I. program at the Franklin Institute in Philadelphia.

The Institute will hold its first annual meeting May 21 at the Carter Hotel, Cleveland, during the Non-Ferrous Founders' Society annual meeting. The group voted to affiliate with the N.F.F.S. as a division of that organization and is expected to occupy space in the Society offices at 1604 Chicago Ave., Evanston, Ill. Herbert F. Scobie, executive secretary, N.F.F.S., is also expected to serve the new organization in the same capacity.

G. F. Langford, president, has in-

vited all producers of finish machined cast bronze bearings to attend and participate in a discussion of their objectives and program.

Chance Vought Aircraft, Inc. . . has contracted with three California foundries to conduct research into three different methods of casting high strength steel parts for supersonic aircraft. The contracts were awarded to Stanley Foundries, Los Angeles; Mercast Corp., La Verne;



Ladle heater is Chance Vought development in metalcasting.

and Pacific Alloys, San Diego, Calif. Primary purpose of this project is to develop processes of casting new high-strength steels into the complex shapes required by the aircraft industries for high-speed aircraft and missiles of the future. Conventional steels cannot withstand the heat generated by extreme speeds of these craft. Tests are being run on special steels to find maximum properties that can be obtained from different types.

Sterling Wheelbarrow Co. . . has changed the company name to **Sterling National Industries, Inc.**

Microcast Division of Austenal, Inc. . . announced the completion of a new four million dollar precision-casting plant designed to permit considerable expansion without halting operations. Wigton-Abbott Corp., engineers and contractors, designed the one-story manufacturing area to feature a structural steel frame of sufficient strength to mount all the hoppers, conveyors and service piping equipment required. This has eliminated the dependence on reinforcement or floor-mounted supports. The new Microcast building is enclosed with prefabricated removal sandwich panels consisting of glass fiber installations between an aluminum exterior and a steel interior surface.

Superior and Malleable Castings Co. . . held their Annual Meeting of stockholders in the company's offices in Benton Harbor, Mich., all of the

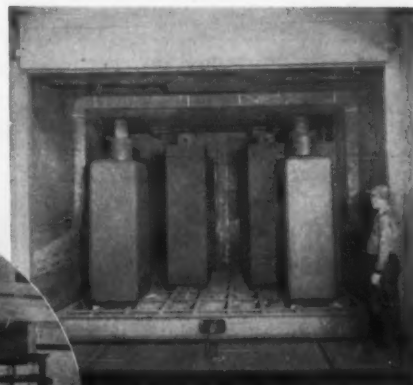
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(above) Car type mold drying oven installed at Centre Foundry, Wheeling, West Virginia.

(left) Rack type Recirculating Gas-Oil Fired Core Ovens at Golden Foundry, Columbus, Indiana.

Write for Bulletin 53-CM

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Circle No. 960, Page 7-8

present directors were re-elected. They are: R. L. Gilmore, S. E. Doster, W. E. Goodman, H. Goodman, H. D. Grant, and D. F. Morris. In the president's report to the stockholders, R. L. Gilmore pointed out that during the past year the company had intensified its sales diversification and product improvement programs and had shipped castings and machined parts to 460 accounts in 34 of the 48 states.

GOOD NEWS!

In times like these when things are admittedly a little tough all over we don't believe in spreading gloom. On the contrary we feel it important to draw your attention to the fact that there is a lot of GOOD NEWS coming from the castings industry. Here are some of the items released during the past months.

International Minerals & Chemical Corp. . . put into operation a new research laboratory in Mulberry, Fla. Mulberry station has 15 pilot plant and sub-pilot plant facilities. This new group brings to 74 the total of scientists and technicians on the I.M.C. research staff there. Equipment includes facilities for differential thermal analysis, x-ray diffraction, spectrography and x-ray spectrography, and high-powered microscopic studies.

U. S. Magnesium Casting Shipments . . summary of March 31 shows slight upward movements marked the shipments of all classes of magnesium castings in January. Total shipments reached 940 tons, 23 per cent above December of 767 tons but 46 per cent below January 1957. Sand casting shipments were up five per cent, 423 tons, against the previous month's

400 tons. Permanent mold shipments were up 21 per cent against December and cast anode up 66 per cent. Die casting shipments made the smallest gain up only three per cent. Tonnage figures are released by the Magnesium Association based on Bureau of Census, U. S. Dept. of Commerce figures.

Non-ferrous Castings . . shipments totaled 182 million lb compared with 171 million lb in the previous month. The January total consisted of 70 million lb copper castings; 58 million lb aluminum castings; 51 million lb

zinc castings, 1.9 million lb magnesium castings and 1.6 million lb of lead die castings.

Link-Belt Co. . . 1957 sales were the second highest in the company's history and were only a fraction under the record 1956 sales of \$183,921,863, president Robert C. Becherer, reported to stockholders. A new plant was completed in Los Angeles and their fourth substantial addition since 1948 was made to the shovel-crane plant of the company's subsidiary Link-Belt Speeder Corp. at Cedar Rapids, Iowa. Construction start-



Steel Founders' Society of America . . held its 56th annual meeting at the Drake Hotel, Chicago. R. L. Gilmore, president, Superior Steel & Malleable Castings Co., took office as president. His past activities included chairmanship of the Personnel Committee in 1945; member of the Research Fund Committee in 1949 and 1950; of the Technical & Operating Committee 1949-1954; Director of Division Six from 1946 through 1948; Chairman of the Product Development Committee, 1951-1954 and representative of the Society on the Board of the Foundry Educational Foundation, 1953-1954.

The Frederic A. Lorenz Medal was presented to retiring president, H. F. Park, Jr., vice president-sales, General Steel Castings Corp., Granite City, Ill., for outstanding services to the steel castings industry.

Vice-president elect is B. P. Hammond,

Foundry & Mill Machinery Div., Blaw-Knox, Pittsburgh, Pa.; Treasurer R. G. Parks, National Malleable Steel Castings Co., Cleveland. Re-elected staff officers include F. Kermit Donaldson, executive vice president; Charles W. Briggs, technical & research director; George K. Dreher, market development director and Edward Dieckmann, assistant secretary. Newly elected directors include C. C. Brownmiller, Treadwell Engineering Co., Easton, Pa.; B. V. Thompson, Jr., Texas Steel Co., Fort Worth, Texas; C. H. Welch, Alloy Cast Steel Co., Marion, Ohio; and Walter A. Miller, Keokuk Steel Casting Co., Keokuk Iowa.

Continuing directors include C. W. Wyckoff, Jr., Atlas Steel Casting Co., Buffalo, N. Y.; B. P. Hammond; John W. Perry, Jr., Grede Foundries, Inc., Milwaukee, E. F. Marquardsen, Pacific Steel Casting Co., Berkeley, Calif.

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Circle No. 963, Page 7-8

ed last year on a new foundry at the Indianapolis Ewart plant will be completed this year. Becherer said "the company is now engaged in its most comprehensive program for development and redesign of materials handling equipment and power transmission products."

Central Foundry Division Defiance plant... to pour malleable iron. Work is already underway to provide the necessary facilities for producing malleable iron. This new operation is expected to create 200 new jobs in the Defiance plant by June. First production item will be malleable automotive door hinges.

American Brake Shoe Co.... set new sales and earning records in 1957 for the second consecutive year according to Kempton Dunn, president, and William B. Given, Jr., board chairman, in a report to stockholders. Net earnings were up two per cent over 1956.

The company's two-year \$30 million expansion and modernization program planned for completion in 1958 will stretch into 1959 and possibly beyond. Capital expenditures for last year were \$11,400,000—the largest in ten years.

Whiting Corp.... Harvey, Ill. has purchased a 40-acre tract of land about a mile south of its main plant for possible future expansion. J. A. Handley, president said "The purchase of this land represents tangible evidence of Whiting's continued faith in the future of Chicago and will offer us space for participation in the increased industrial activity we feel sure will shortly be centered in South Cook County".

Cleveland Crane & Engineering Co.... Wickliffe, Ohio has broken ground for a new 11,400 sq ft Research and Development Building. Cleveland Crane manufactures heavy overhead traveling cranes, tramrail overhead materials handling equipment, heavy metal-cutting shears, press brakes and forming presses.

The building, scheduled for completion in June will include a modern equipped air-conditioned engineering department; complete shop and testing facilities for assembling; handling and testing equipment under development.

General Electric Company's Foundry Department... announced plans for establishing a \$3,700,000 steel casting foundry which will be located in the present Iron Foundry building, Schenectady plant. The foundry will help to meet the ever-increasing need

Small Parts ?



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IN YOUR OWN PLANT
WITH MINIMUM INVESTMENT
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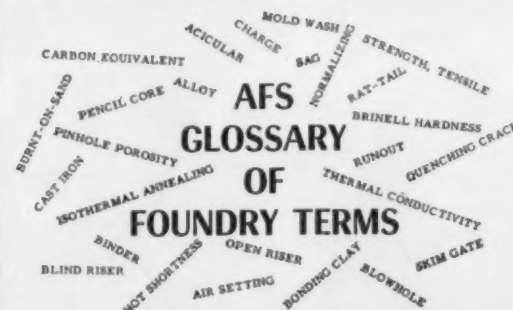
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Circle No. 964, Page 7-8



Including almost 2000 terms, this book is intended to help standardize the meanings of foundry terms throughout the metal castings industry. In its preparation, reference was made to many presently existing glossaries and dictionaries of scientific and engineering terms. IT IS THE MOST COMPLETE WORK OF ITS KIND and should be at the finger-tips of every member of the metal castings industry. (80 pp. 6 x 9 Paper Bound.)

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of the electric utility industry. Capacity for manufacturing the larger iron castings will be retained as an integral part of the new facility. Re-equipping the plant will begin this summer and is to be completed in 1960.

Scheduled for installation in the projected steel castings foundry will be an electric-arc furnace capable of melting over 200,000 lb of steel or high-grade iron. It will be equipped with an induction stirring device which will provide the most advanced refining process in the industry. This will be one of the largest furnaces of its type. According to the Foundry Department engineers, the new steel foundry will permit an increase in its steel casting production at Schenectady of about 50 per cent over present levels.

Frank G. Hough Co., Libertyville, Ill., presented to one of their distributors the 10,000th model HA "Payload" tractor-shovel produced by them. An exchange of congratulations were called for between Hough president, G. A. Gilbertson, and C. T. Mitchell, president of How-



The 10,000th "Payload."

ell Tractor and Equipment Co. The Hough firm has been instrumental in promoting multiple usage of tractor-shovels of all sizes by developing and encouraging the design of various front-end attachments to be used interchangeably with the standard bucket.

American Steel Foundries' stockholders were addressed at the 55th Annual Meeting in Chicago by Charles C. Jarchow, president. He stated both sales and earnings were higher in the first quarter of the 1958 fiscal year than the comparable period in 1957.

The directors will continue to evaluate earnings and working capital each quarter when determining dividend action. However, it appears that earnings will be large enough to continue the 60 cent quarterly dividend rate in the current year.

Blaw-Knox single line type buckets improve foundry handling operations

Blaw-Knox single line, hook-on type foundry buckets are especially designed for efficient operation under all types of headroom conditions. In addition, their quick-detachable feature permits the bucket to be released instantly, freeing the crane for other duties. Special shark-tooth types are available for handling coke with a minimum of degradation.

Blaw-Knox sales engineers can study your requirements and apply the bucket best suited to your needs.

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Normal headroom usually accommodates standard Blaw-Knox Foundry Buckets of either the open head or closed head types.

Circle No. 966, Page 7-8

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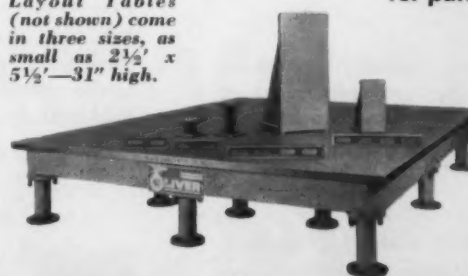
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Circle No. 965, Page 7-8

New... OLIVER Layout Plates and Tables

Layout Tables (not shown) come in three sizes, as small as 2½' x 5½'—31" high.



for pattern shops... or wherever accurate production work is essential

In making patterns, the surest way you can insure accuracy, expedite work and save money is the use of a Layout Plate or Table. The Layout Plate shown is 9' x 12'-9½" thick, heavily ribbed, stress-relieved. It's flat within .005" overall and within .002 per section. Smaller and larger sizes with various accessories available.

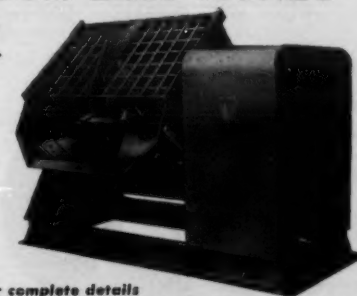
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Circle No. 967, Page 7-8

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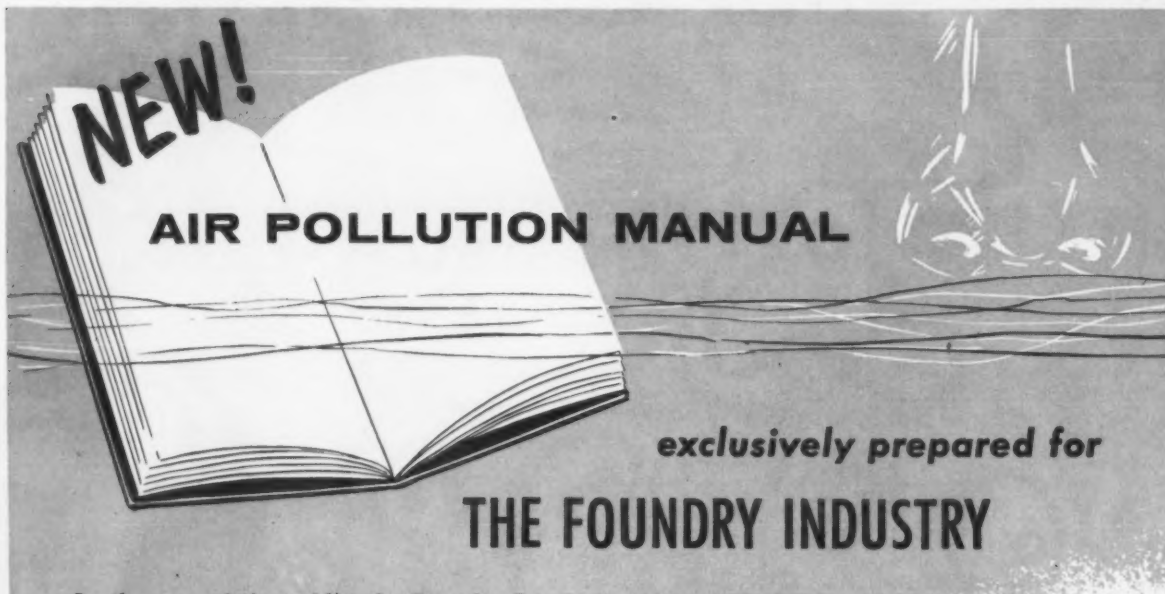
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- Mixes all binders



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Circle No. 968, Page 7-8



In the eyes of the public, the Foundry Industry is a major source of Air Pollution! Yet, in a comparison with other basic industries, less equipment is needed by the foundry industry to reduce pollution of the air by contaminants than in the others.

In the light of existing conditions, the Foundry Industry's major problem is to have technically accurate information for controlling air pollution in specific operations and locales.

Only in this way can Foundry Operators proceed with confidence in establishment of community relations and development of laws, equally compatible for industrial and residential acceptance.

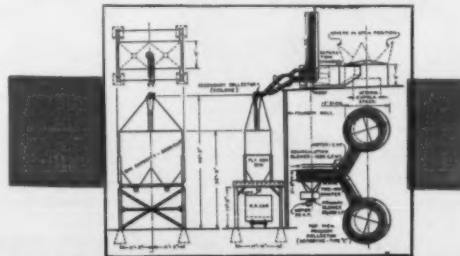
This **AIR POLLUTION MANUAL**, written by men of the foundry field for the foundry field, will enable management to move forward with confidence . . . not only in the selection and maintenance of suitable equipment but, equally important, in compliance with "good neighbor" policies.

Comprehensive sections cover:

1. Foundry Industry's Air Pollution Problem
2. Review of Existing Ordinances
3. Community Relations
4. Atmospheric Sampling and Analysis
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Their financial position remains strong even though the company is currently experiencing a temporary decline in its sales volume.

National Malleable & Steel Castings Co. . . enjoyed the third best year in the company's history in 1957. Cleve H. Pomeroy, chairman, and president Carter Kissell stated "Sales had a drop of less than one per cent in 1957 as compared with the previous year". This was attributed to fine business in the railroad industry which helped offset a relatively dull market in automotive and agricultural equipment fields. Performance by the relatively new mine and mill division and Capitol Foundry division contributed appreciably to the year's success.

Capital Brass & Aluminum Foundry Co., Chicago, has purchased the assets of Smeeth Harwood Co., and has moved all equipment to the capital plant. The purchased company will be operated as **Smeeth Harwood Div.**, of Capital. H. A. White will continue in charge.

Jules Parisi, president of Pekay Machine & Engineering Co., Inc., Chicago, upon advice of their export representatives, **R. K. Price Associates, Inc.** is presently in Europe investigating sales possibilities for the various Pekay advanced foundry and control equipment. Parisi's findings will enable the company to determine if sales should continue to be made from the United States or if manufacturing of the equipment should be started in Europe.

Testing Symbol Standards in New A.W.S. Publication

■ Standardization of non-destructive testing symbols for use on drawings specifying tests for determining soundness of materials has recently been accomplished by the members of the American Welding Society. Officials report that the new standards make it possible for the first time to specify in a single symbol the type of test desired; radiographic, magnetic-particle, penetrants or ultrasonic.

Welding symbols may also be combined with non-destructive testing symbols, giving complete welding and testing instructions in one symbol. The basic symbols, the general provisions concerning their use, and the methods of specifying the extent of tests are covered in a publication offered by A.W.S.

■ For additional information, circle No. B page 7-8.

Supervisory Personnel Must Learn Radiation Hazards

■ Radiation occupies a more prominent position in people's minds than other equally important industrial hazards. It is important to educate supervisory personnel in all departments regarding radiation, its hazards, detection, controls, and so as to aid radiography department personnel in the control of radiation areas. If all supervisory personnel can be completely informed, less likelihood exists of misinformation reaching non-operating personnel, including management.

Metallurgist

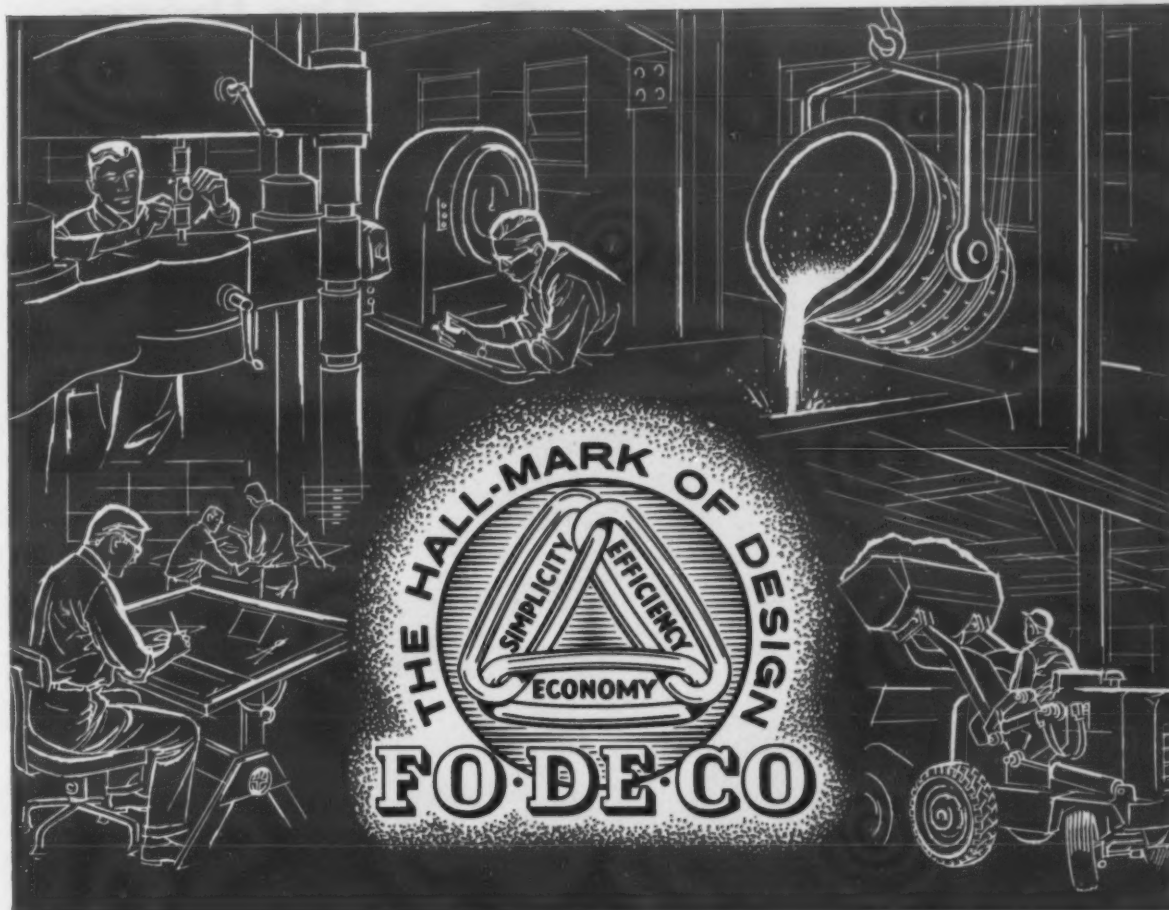
Functions of the metallurgist include determining sections of castings to be radiographed and interpreting the finished radiograph in order to determine whether customers' requirements and plant standards are being met. To properly utilize the radiographic facility, operating personnel should be well versed in theory of x-radiography and/or gamma radiography, the effects of different wavelengths or voltages, distances from the source to the object, size of the source of radiation and types of x-ray film.

Type of equipment and its use are determined by the type of material cast, thickness, physical shape and size, quantity of work, available facilities. Supervisory personnel must be well versed in all facets of metallurgy if proper film interpretation is to be achieved.

Controlling Radiation

Responsibility for control of the amount of radiation received by personnel rests with the radiography department supervisor. He controls number of radiographs taken per week, areas which are roped off, shielding necessary during heavy workloads. He and his subordinates must possess a thorough knowledge of radiation health physics, understanding completely the hazards involved.

In many cases, operators of radiography equipment may take the responsibility of determining kilovoltage, distance, and film exposure time. Time and money is saved by employing operators who can do preliminary interpretation of the finished radiograph. By alternating operators between machine and darkroom, total amount of radiation received can be considerably reduced. Operators must know how to use control instruments; and what radiation limits are, stopping operations in case of accident, and reporting to supervisors that limits are being approached.



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Circle No. 969, Page 7-8

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American Steel Foundries
A sound text for a study of the technical aspects of the American foundry industry and an excellent reference manual.



CHIEF METALLURGIST

Angelo Dylis
Sterling Foundry Co.
Every metallurgist, designing engineer, and shop library should possess this book. It not only mentions practically everything in the casting process, but gives references to further information on any subject.

COVERS . . . molding process including the sand casting methods, shell molding, die and permanent mold casting, investment, etc. Mold materials and construction, molding equipment, solidification of metals, gating and feeding of castings, molding sand technology, cleaning of castings, castings design, metallurgical principles associated with melting, composition of casting alloys and their properties, heat treatment, and metallurgical processing characteristics of foundry practices. No processes other than metal casting are considered.

Principles associated with molding processes and materials and solidification of metals are presented in the first eleven chapters; the principles are then interpreted for the specific casting alloys (fourteen chapters). Special metallurgical principles of melting, alloying, heat treating, and metallurgical processing are confined to portions of the latter fourteen chapters.

Prepared by Richard W. Heine and Philip C. Rosenthal of the University of Wisconsin, Madison, Wisconsin.

CASE BOUND

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The Patternmaker

■ Patternmakers are the highly skilled craftsmen who construct patterns and core boxes—the forms used to shape molds and cores. They are classified, primarily, according to the kind of material they use in making patterns. About half of the 15,000 patternmakers construct metal patterns. Of the remainder, most are wood patternmakers, although a few work with other materials, such as plaster.

A patternmaker works from blueprints and plans the pattern, taking into consideration the manner in which the object will be cast and the type of metal to be used. The wood patternmaker selects the appropriate woodstocks and lays out the pattern, marking the design for each section on the proper piece of wood. Using power saws, he cuts each piece of wood roughly to size. He then shapes the rough pieces into their final form, using various woodworking machines—such as borers, lathes, planers, bandsaws, and sanders—as well as many small handtools. Finally, he assembles the pattern segments by hand.

Metal Patternmaker

The duties of a metal patternmaker are much the same as those of wood patternmakers except that he uses metal and metalworking machines instead of wood and woodworking equipment. Metal patternmakers prepare patterns from metal stock, or more commonly, from rough castings made from an original wood pattern. To shape and finish their work, they use a variety of metal-working machines, including the engine lathe, drill press, milling machine, power hacksaw, grinder, and shaper.

Throughout his work, the patternmaker carefully checks each dimension of the pattern. A high degree of accuracy is required, since any imperfection in the pattern will be reproduced in the castings made from it. Other duties of patternmakers include making core boxes (in much the same manner as patterns are constructed) and repairing patterns and core boxes.

Two Types of Shops

Patternmaking is done in specially equipped pattern shops, which are of two types—-independent and integrated. In mid-1956, employment of patternmakers was about equally divided between the two types of shops. Independent pattern shops are separate establishments which make patterns on order for other firms. An integrated shop may be operated in conjunction with a foundry which uses the patterns, or it may be the pattern de-

.... A Skilled Craftsman

partment of a plant that buys castings from a commercial foundry.

Apprenticeship, or a similar program of on-the-job training, is the principal means of qualifying as a journeyman patternmaker. Because of the high degree of skill and the wide range of knowledge needed for patternmaking, it is very difficult to obtain the necessary training by informally picking up the trade. However, in some instances skilled machinists have been able to transfer to patternmaking with additional on-the-job training or experience. Good trade school courses in patternmaking provide useful preparation for the prospective apprentice, and may in some cases be credited toward completion of the apprentice period. However, these courses do not substitute for apprenticeship or other on-the-job training.

Apprenticeship Period

The usual apprenticeship period for patternmaking is 5 years, or about 10,000 working hours. At least 720 hours of classroom instruction in related technical subjects is normally provided. There are separate apprenticeships for wood and metal patternmaking.

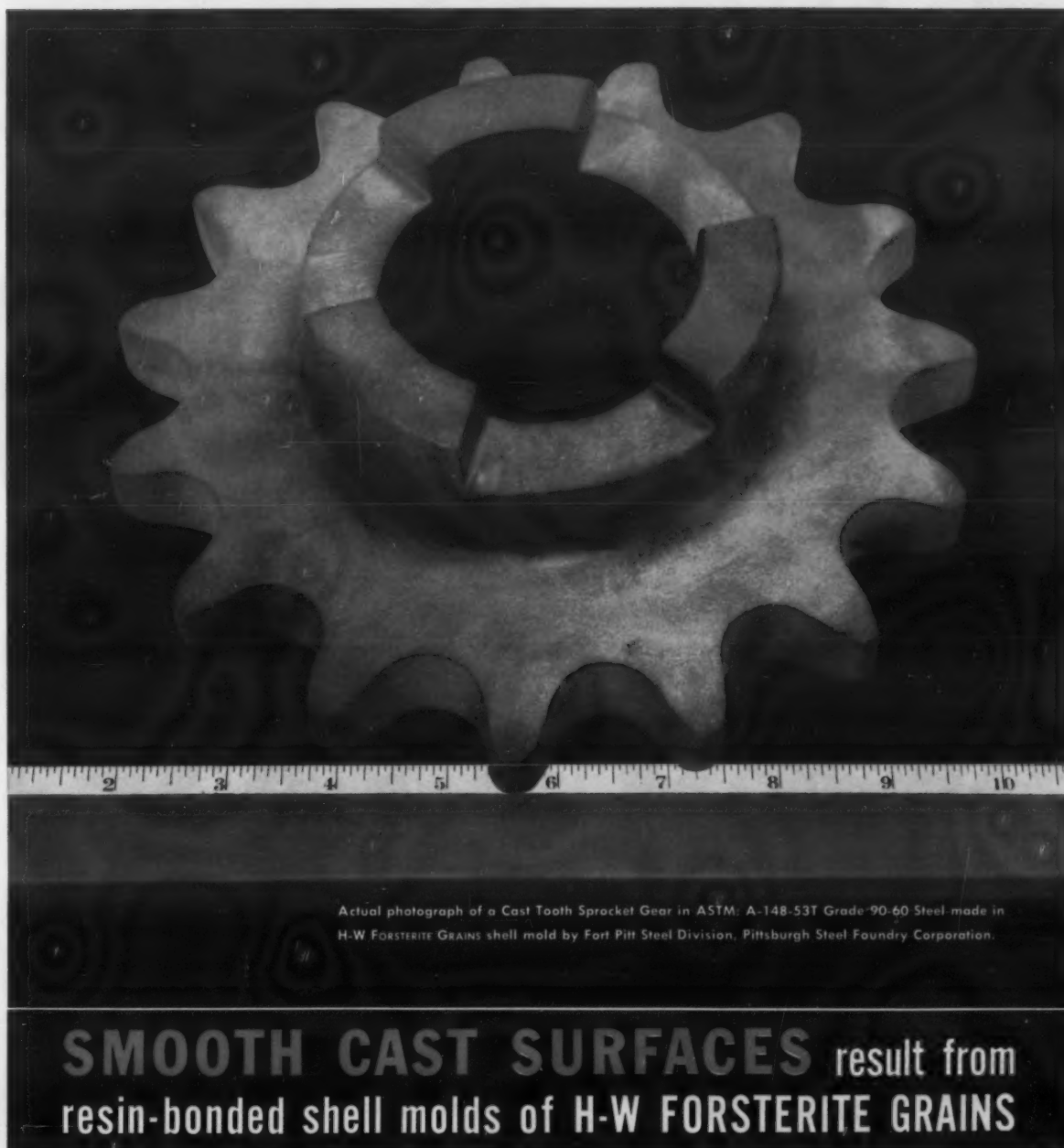
The patternmaker apprentice begins by helping journeymen in routine duties. Then he makes simple patterns under close supervision, gradually learning to use the various types of machine and handtools. As his training progresses, the work becomes increasingly complex and the supervision more general.

Patternmaking, although not strenuous, requires considerable standing and moving about. A high degree of manual dexterity is especially important because of the precise nature of many hand operations. Employers generally require apprentices to have at least a high school education.

Employment Outlook

Little change in the number of patternmakers is expected in the late 1950's and the 1960's. Despite the increase in foundry production, the number of patternmakers has not grown significantly for several decades. Mass production, which has meant the preparation of large numbers of identical castings, is resulting in greater use of metal and plastic rather than wood patterns. The more durable metal patterns can be used many times in the making of identical molds and thus the number of individual patterns required for a given number of castings has declined. It is ex-

Continued on page 176



Actual photograph of a Cast Tooth Sprocket Gear in ASTM: A-148-53T Grade 90-60 Steel made in H-W FORSTERITE GRAINS shell mold by Fort Pitt Steel Division, Pittsburgh Steel Foundry Corporation.

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pected that this trend will continue at least during the 1956-1966 decade.

Replacement needs will provide job opportunities for new workers to be trained as patternmakers. It is estimated that about 500 new patternmakers will be needed annually during the 1956-1966 decade to replace workers who die, retire or transfer to other fields of work. Most job openings will be in metal patternmaking.

Because patternmakers learn either the basic metalworking or woodworking skills, they can find jobs in related fields when patternmaking employment is not available. Wood patternmakers can qualify for skilled woodworking jobs such as cabinetmakers, and metal patternmakers can transfer their skills to machine shop jobs such as machinists or layout men.

■ Reprint from *Foundry Occupations*, United States Department of Labor Bulletin No. 1215-10.

Brass and Bronze Foundries Seek Broader Market Areas

■ Many brass and bronze foundries, faced with a buyers' market and decreased demand for products in many lines, are seeking ways to broaden market areas, modernize marketing methods, increase acceptability of product, lower production costs, and increase efficiency. H. B. Gardner, Copper Div., Business and Defense Services Administration, Washington, D. C., reports foundries whose programs are meeting with success are agreed on certain basic principles.

First, they say, an aggressive marketing program is necessary for successful operation of a foundry whether jobbing or captive; in today's expanded markets, each individual foundry competes with other fabrication methods as well as with other foundries. But they emphasize that marketing is more than simply selling; that more attention to design, assurance of uniformity and high quality of product, prompt delivery, and service should all be considered as factors.

Lowering production costs is another imperative. Use of more skilled manpower and better machinery and equipment now available are being studied on a production basis, dollar-wise. New techniques and new methods of operation are also closely examined. These include the use of shell molding, the carbon dioxide process, closer control of foundry sands, ceramic molds (especially in precision casting), low-frequency induction melting, and the substitution of specially treated bentonite wetted with petroleum oil instead of water to obtain improved casting finishes.

Alex Dreier to Salute the Castings Industry on Radio

■ Alex Dreier, the "man on the go," will salute the metalcasting industry during a nationwide radio program Sunday, May 18, over NBC-Monitor. The broadcast, 6:05 pm (E.S.T.), will be aired over the entire NBC network of nearly 200 stations. The tribute is timed to tie-in with the AFS 62d Castings Congress and Foundry Show to be held in Cleveland, May 19-23.

The broadcast is one of a series called, "America on the Go," sponsored by American Van Lines, Inc.,



Fort Wayne, Ind.

Dreier will tell his audience of 9,000,000 radio listeners that the art of casting metal, which dates back to about 4,000 B. C. but has made its most important strides since the end of World War I, is the basis of all modern engineering. But the foundry industry, he will add, is one of the least known and least understood.

He will challenge the public to imagine a world without cast metal forms—a world without bridges, ships, skyscrapers, agricultural implements, automobiles, railroads or aircraft.

Dreier will relate how ancient man, after discovering gold, copper and tin, accidentally found a way to melt down metal-bearing rocks and cast his utensils and weapons to exact shape in stone molds. He will tell the public that iron, when first discovered, was used for ornaments; and that no metal assumed importance to mankind until some ancient craftsman poured the bellows to make a fire hot enough to melt metal. He then combined the idea with the refractory quality of clay for molds.

This new program series marks the first time in history that nation-wide consumer attention has been directed to industrial expositions and shows.

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Circle No. 973, Page 7-8

Bentonite Tests Establish Producer Specifications

■ After solving a serious, recurring epidemic of scabs, mold tears, sand brittleness, etc., several years ago, my co-worker, Gary Grott, and I set about to analyze the direct cause and solution of the problem. In 1953 we explained our solution, showing how a change in pH value of a ten per cent bentonite slurry affected the yield strength, the change in pH being accomplished with various additives.

The change in yield reflected a variation in the colloidal solution of the bentonite. As the pH dropped, the yield was lowered because the bentonite was being flocculated or curdled. This reaction also occurs and affects the bentonite in a sand-bentonite mixture when the pH changes.

High pH

Since western bentonite is a sodium-montmorillonite clay, the pH is inherently high; and conditions within the molding-sand mixture that would lower the pH could adversely affect the quality of the mold and casting.

Many factors cause this condition; weather, souring of the sand, acid water, cereal flour, mold gases (CO₂), insufficient sodium or excess of calcium in the bentonite, etc. One of our problems was a bentonite with a 5.6 pH.

Many of our fellow steel foundrymen began controlling the pH and specifying it on their bentonite. Bentonite producers, recognizing that steel foundry bentonite must be of high quality, must more closely control their stripping operations, drying methods, and the sodium-calcium ratio.

Although many of us checked the pH factor of bentonite shipments, occasional troubles still occurred. Were there other factors or qualities of western bentonite contributing to successful use in the steel foundry? Were these characteristics measurable? There was no acceptable numerical index that could be derived from or applied to a test measuring bentonite quality.

Research Project

The Steel Founders' Society, in 1955, entered into a project developing qualifying tests and specifications. Meetings were held with producers and a research project was set up at the Massachusetts Institute of Technology, Cambridge, Mass., to investigate and develop rapid, reproducible qualifying tests that would be reasonable in cost and acceptable to producers and foundrymen.



by V. E. ZANG
Unitcast Corp.
Toledo, Ohio

The Liquid Limit (WL) test, modified by M.I.T. professor, Howard Taylor, was introduced in 1956. At the same time, our company reported on a plastic viscosity test which seemed to correlate well with molding characteristics.

Both tests indicated similar properties; but an equipment cost differential of about \$350 favored the Liquid Limit test. Equipment variations were eliminated by standardizing the slurry mixer, test cup and groover. We selected eight samples which represented a gradual, decreasing liquid limit.

An explanation of the salient points of the control factors follows:

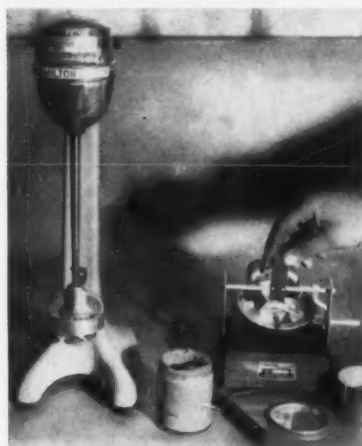


Fig. 1—slurry mixer and test cup

Moisture

Clay, as mined, contains 22-30 per cent moisture and must be dried for use. The specification sets 6-12 per cent as the acceptable moisture.

pH

The minimum acceptable value is 8.2, determined electrometrically in a 6-8 per cent solution of bentonite. Water should be neutral or 7.0 pH.

Calcium Oxide

A minimum sodium to calcium ratio of two to one should prevail in western bentonites. Calcium oxide maximum is set at 0.70 per cent.

Liquid Limit

The liquid limit, using the standardized S.F.S.A. method, is set at

Continued on page 199

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questions and answers

Misery loves company so why not share your castings problems with us? Modern Castings invites you to stump the experts with tales of gremlins that are haunting your scrap piles. If any of you readers have better answers to the questions below, write the editor.

Q. Is there any other way of removing sand from the surface of castings than by blasting or grinding? I have heard that it can be done chemically.—P.G.

A. Yes sand can be removed by immersion in a hot caustic salt bath held at 700-1000 F. The hot caustic also removes scale from the castings. In some units dc electricity is used for special benefits. Hot castings are

usually removed from the caustic bath and slowly lowered into water so the steam formed loosens or removes a substantial portion of the adhering scale which has been reacted chemically at the surface.



Q. In ordering limestone for the cupola do you have any particular specifications or requirements that the limestone should meet in order to perform its fluxing action properly?—L.L.W.

A. There really aren't too many criteria for judging quality of limestone. Both pure limestone and dolomitic limestone (containing magnesia) seem to work equally well in the cupola. Generally speaking, limestone should not contain in excess of 2 per cent SiO_2 since any silica present will react with the limestone and decrease its effectiveness as a flux. To perform to best advantage in the cupola, limestone should be crushed to pass a 2-in. screen and be held on a 3/4-in. screen.



Q. We have been trying to pour pure copper castings and find ourselves in the non-ferrous swiss cheese business with plenty of product but no customers. Is it possible to make sound copper castings?—K.L.M.

A. You bet it is but it's not easy. First you should start off with virgin copper ingot and place it in a graphite crucible. On top of the charge put dry, dust-free charcoal. Lay a cover on the crucible. After metal is melted and just prior to pouring, the metal must be deoxidized. Phos-copper, lithium, and calcium boride are three deoxidizers that will do the trick. The latter two are usually sealed in a short length of thin walled copper tubing. If the melt weighs 250 lb and you are using calcium boride, the melt should be treated with about 10 oz of the addition agent. The capsule should be submerged quickly beneath surface of melt and held there with

tongs or some special holding device. After the violent reaction has stopped, stir with an iron rod and pour at about 2200 F. With a little bit of experience you'll soon be making sound copper castings.

Q. In making nodular iron there is a brilliant white light given off when the molten iron comes in contact with the magnesium. Do workers in the vicinity of this flash need special eye protection?—G. S.

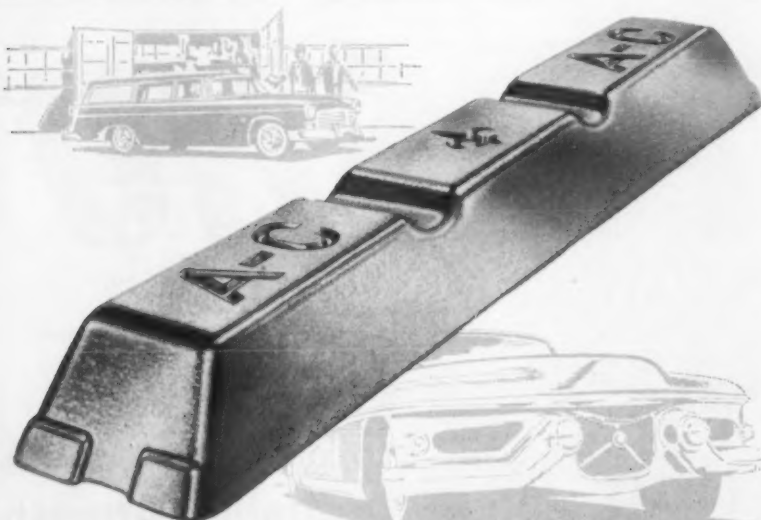
A. Actually this bright flash is not particularly dangerous. After all most photo-flash bulbs burn magnesium to supply the light for taking pictures. Ordinary safety glasses will give sufficient protection. However the secondary hazard of being temporarily blinded by the brightness of the flash would suggest the desirability of using tinted glass in goggles. Select a shade of glass that prevents blinding and at the same time permits men to see what they are doing.



Q. Can CO_2 cores be used in making steel castings? If so, what is a good mix?

A. Steel foundries are finding many successful applications for CO_2 cores. Some foundries are also making molds bonded with sodium silicate and subsequently hardened with CO_2 gas. One steel foundry has found the following mix suitable for their needs: 200 lb silica sand with 55 gfn, 100 lb silica sand with 100 gfn, 15 lb sodium silicate, 2 lb cereal, and 2 lb iron oxide. For a batch this size mulling time is 5 minutes. Physical properties for the mix are: 2 per cent moisture, 134 green permeability, 151 dry permeability, 1 psi green strength, and 65 psi dry strength.

After mulling, the sand mix needs to be protected from the hardening effects of CO_2 present in the air as well as drying tendencies. Damp sacks thrown over the batch will give adequate protection for the relatively short periods which precede use in cores or molds. If hot deformation or expansion proves to be a problem, zirconite sand can be used in critical areas or 1-2 per cent of kaolin can be added to the mix.



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Circle No. 973, Page 7-8



dietrich's corner

by h. f. dietrich



The Foundry Foreman

To the men working under him, the foundry foreman represents the company for whom he works. In the foreman the worker sees the expression of company attitude and policy. In my travels I have met some odd characters who by ambition—and perhaps astute shop politics—have become foremen.

Of the ambitious type there was Old Joe. He always carried a complete supply of vibrator springs, wood screws, wrenches, pliers and a screw driver. Just as surely as a foreman carries such equipment, someone will call on him to use it; and Joe spent more time at maintenance than as a mechanic.

Joe had his own way of ramming every mold. If a molder deviated slightly from Joe's technique, he would stay with the man until every movement of his corresponded to Joe's method. As a result, he made more molds than any man under him.

At heat time, Joe stood beside the receiving ladle and called the name of each man to break the stream. It sounded like an army sergeant calling roll. After a few weeks of work under Joe, a molder would hesitate to exhale unless Joe gave his permission. His autocratic rule was total and complete.

Joe finally wound up with a coronary condition and a set of peptic ulcers that were a marvel of the medical world.

At the opposite extreme was the Phantom. None of the molders ever saw the Phantom. He worked through a stooge gangwayman. Patterns appeared on the benches, orders were delivered by the gangwayman, and metal was delivered to the floor with no visible direction. Mistakes were corrected by the simple expedient of attaching a pink slip to the time card and hiring another molder. I always suspected that the Phantom got his job by marriage to the boss's daughter.

Another odd character was Marcus. He became a professional cigarette chiseler. A doctor once told him to quit smoking and Marcus misunderstood him. He merely quit buying. Being a man of discriminating tastes, he was never known to smoke anything except the best tailor-made brands. For him, Bull Durham held no charm. He gave his chiselling tactics dignity by calling them "borrowing," but no one ever heard of him returning what he had borrowed.

Marcus was punctual. We could tell the time by watching his progress through the foundry. He would arrive at the roll-over machines just before the heat. It was the last chance he would have at those molders until the following day.

I suppose every man sets a price on his integrity. The price Marcus set must have been low to justify his petty kick-back system. If he is no longer with us, I would bet 8 to 5 that he borrowed the tools of his present occupation—either a harp, or a scoop, depending on his destination.

Then there was the Dreamer of the Quad Cities. I hired out in his department on Friday to start work Monday. When I looked at my floor I found the squeezer buried in dry sand.

The Dreamer was talking to one of his cronies about a lost weekend and I didn't get his attention until after noon. The job he gave me ran out of cores in an hour. His method of correcting errors was to pass the job from one molder to another until he found someone who could make it. Old Dreamer couldn't tell you anything about any job.

In traveling from foundry to foundry I have met some good foremen, gentlemen who made you feel that the company was worth working for. From each of these, good or bad, I tried to learn something useful. But, if the foundry foreman represents the company for whom he works, I have worked for some companies with strange labor policies.

PERMABRASIVE



is the only
pearlitic malleable
shot and grit
on the market!

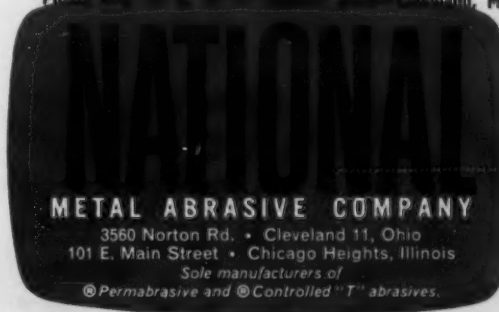


Forty 50 lb. cartons in one master pack: easy to store, easy to inventory, easy and safe to handle. **No Extra Cost to you.** (Also in conventional 100 lb. or 50 lb. bags.)



A free, no-obligation, lab analysis on your blastcleaning efficiency. See where your money goes. **No Cost to you.**

Please look for



Result? More durable structure, greater resistance to breakdown, longer life, greater cleaning ability, lower abrasive costs, lower maintenance costs, faster cleaning.

©PERMABRASIVE is better than steel shot and grit because it contains more cutting carbides producing a much, much faster cleaning time; add its lower price and you have an obvious savings in costs!

©PERMABRASIVE is better than ordinary annealed shot and grit because it has more cutting carbides and less graphitic carbon—because it has less phosphorus content indicating a resistance to breakdown—and because the cutting carbides are held in a unique ductile matrix; this means a much, much longer abrasive life with an obvious savings in costs!

USERS SAY

"Using (blank) annealed abrasive, the consumption per wheel-hour was 18.4 lbs.; with PERMABRASIVE the consumption was 14.7 lbs. . . . a reduction of 20.1%."

"We checked the performance of PERMABRASIVE vs two brands of Steel Shot. Results:

PERMABRASIVE . . . \$.81, Steel Shot—Brand A . . . \$1.48, Steel Shot—Brand B . . . \$1.04."

"Used PERMABRASIVE in test against mixture of Steel and Annealed Shot. Abrasive cost per wheel-hour with PERMABRASIVE was \$.93, against \$1.17 for the mixture . . . a savings of 20.5%."

Cleveland, May 19-23. Booth 219 Arena

Sold Exclusively by
**HICKMAN, WILLIAMS
& COMPANY (Inc.)**

Chicago • Detroit • Cincinnati
• St. Louis • New York • Cleveland
• Philadelphia • Pittsburgh
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Exclusive West Coast
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**BRUMLEY-DONALDSON
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WRITE DEPARTMENT 11-A

Circle No. 976, Page 7-8

May 1958 • 181

We'll be expecting you . . .

SEMET-SOLVAY FOUNDRY COKE EXHIBIT BOOTH #708

Discuss your specific foundry coke problems with our friendly staff.

See the range of coke sizes available to you.

Take a color film trip through our coke making operation.

AMERICAN FOUNDRYMEN'S SOCIETY

62nd. Annual Castings Congress and Foundry Show
Cleveland Public Auditorium
May 19 to 23, 1958



SEMET-SOLVAY DIVISION

Allied Chemical Corporation
40 Rector Street, New York 6, N. Y.

Buffalo • Cincinnati • Cleveland • Detroit
Semet-Solvay Company, Ltd., Toronto

Circle No. 977, Page 7-8

Control Foundry Chilling with




CHILL NAILS and SPIDERS

Choose any style chill nail from jumbo to stubby; slim, medium, or horse nail blade; blunt, pointed, straight or 90° bent. Some types available in Stainless, Brass, Aluminum; Copper coated to order. Spider Chills, jumbo or horse nail legs—double or single. Available in various sizes and types; also made to your individual specifications.

Write for detailed descriptions and prices.



Other Products
FINE STEEL Stanho PRODUCTS KEYS
SPECIAL PARTS



VISIT OUR EXHIBIT • BOOTH 319-B, ARENA HALL • AFS FOUNDRY SHOW
Circle No. 978, Page 7-8

182 • modern castings

Build an idea file for plant improvements.
Reader Service Cards, page 7-8
will bring more information . . .

for the asking

Labor relations reprint . . . states 5000 small foundries are without full-time counsel (or labor-relations staff) while active unions receive expert advice. To relieve the imbalance author believes greater interchange of information by management is needed. *National Foundry Association.*

Circle No. 861, Page 7-8

Index to 1957 issues . . . of MODERN CASTINGS available. Valuable cross-references by subject, author and company enables the reader to find material immediately and with a minimum of effort. For your free copy circle No. 862, Reader Service Card, page 7-8.

Zinc industry activity . . . during 1957 is the subject of a 16-p booklet summarizing zinc production and consumption in the United States. Detailed reports on imports, tariff rates, zinc uses by grades, and other subjects are contained in this booklet. *American Zinc Institute, Inc.*

Circle No. 863, Page 7-8

Foundry practice . . . bulletin includes four technical articles dealing with: aluminum rotor castings with cavities, copper-tin alloys—bronzes and red brasses, pressure and exothermic feeding of iron castings, and ABC of heat treatment. *Foundry Services, Inc.*

Circle No. 864, Page 7-8

Carbon sand . . . a new molding material composed of particles of hard carbon is described and compared to other molding sands in 16-p booklet. Covers mixing, ramming, baking, cleaning, and shakeout. *J. S. McCormick Co.*

Circle No. 865, Page 7-8

Rules for plant safety . . . are included in descriptive brochure which includes in a 40-p booklet safety rules for using power tools, stacking materials, lifting and carrying. *National Safety Council.*

Circle No. 866, Page 7-8

Pearlitic malleable castings . . . are discussed concerning design adapta-

bility in folder illustrating castings made with this and other materials. Design, weight, strength, and cost are compared. *Malleable Founders' Society.*

Circle No. 867, Page 7-8

Power roof ventilators . . . explained in selection guide. Dimensions, capacity tables, and details on accessories



and protective coatings on the low-silhouette units are covered in the bulletin. *ILG Ventilating Co.*

Circle No. 868, Page 7-8

Engineering accomplishments . . . during 1957 covering research, metals and mining, nuclear power, general industry, plant facilities, and other subjects are presented in illustrated, 36-p annual publication. *Allis Chalmers Mfg. Co.*

Circle No. 869, Page 7-8

Safety talks for foremen . . . are the subject of descriptive literature covering a book of 52 talks on safety designed for presentation by plant foremen. The book includes balanced coverage of all major types of occupational accidents. *National Safety Council.*

Circle No. 870, Page 7-8

Concrete curing agent . . . data sheet describing how to employ on new and old concrete floors. Includes application specifications and performance figures, and explains how the product dustproofs and rejuvenates old floors

as well as effectiveness as curing agent and surface hardener on new floors. *Walter Maguire Co.*

Circle No. 871, Page 7-8

Microphotometer data sheet . . . covers uses of the instrument for measuring photographic densities of exposed spectrographic and x-ray plates. The 4-p folder details features on photographs of the company's scanning and recording units. *Leeds & Northrup Co.*

Circle No. 872, Page 7-8

Industrial vises . . . for use on drill presses and machinery are covered in new catalog. New drill press vise



and latest design improvements on company's air-hydraulic vise are included. *Wilton Tool Mfg. Co.*

Circle No. 873, Page 7-8

Wall chart . . . 17x22 in., displays full line of industrial gloves giving all necessary specifications of each model, material, weight, and size, *Pioneer Rubber Co.*

Circle No. 874, Page 7-8

Pocket folder guide . . . offers instructions for selecting correct glove for particular industrial applications. Includes glove selector check list and chemical performance ratings from tests using acids, greases, oils, and various chemicals. *Pioneer Rubber Co.*

Circle No. 875, Page 7-8

Steel castings operations . . . depicted in picture booklet, 18 pp, taking the reader through manufacturing steps in producing stainless, carbon, and alloy steel castings. Booklet also describes modern in-plant materials handling systems employed by the company. *Empire Steel Castings, Inc.*

Circle No. 876, Page 7-8

Shell molding release agent . . . of silicone emulsion is available as trial sample; data sheet will also be sent. *General Electric Co.*

Circle No. 877, Page 7-8

Uses of beryllium . . . are discussed in 15-p booklet. Cost, availability, brittleness, and toxicity are subjects in-

Taylor & Company specializes in versatility with HANNA PIG IRON

Taylor & Company, Inc., Brooklyn, New York, casts them little and big with equal ease—from dry-sand castings that weigh tons, to light close-tolerance parts cast by the shell-molding process. As many as 6,000 different patterns are used by Taylor in an average month.

For seventy-five years, this merchant foundry has turned out a variety of sizes and shapes with the aid of high-quality Hanna pig iron, especially Hanna Malleable and Hanna Silvery grades. President William Z. Taylor has never failed to find Hanna a dependable source of supply for any analysis he needs to meet his customers' requirements.

Whatever you cast, there's a Hanna iron to do it best. All regular grades of pig iron, plus HannaTite and Hanna Silvery, are available in 38-pound pigs and the smaller HannaTen ingots. For prompt service, call on one of Hanna's trained representatives.



△

This 6-ton dry-sand casting will be a machine tool base that stands up to vibration and shock, provides a rock-steady foundation for accurate work.

◁

These small parts were cast to close tolerances by the shell-molding process, and need little or no machining.

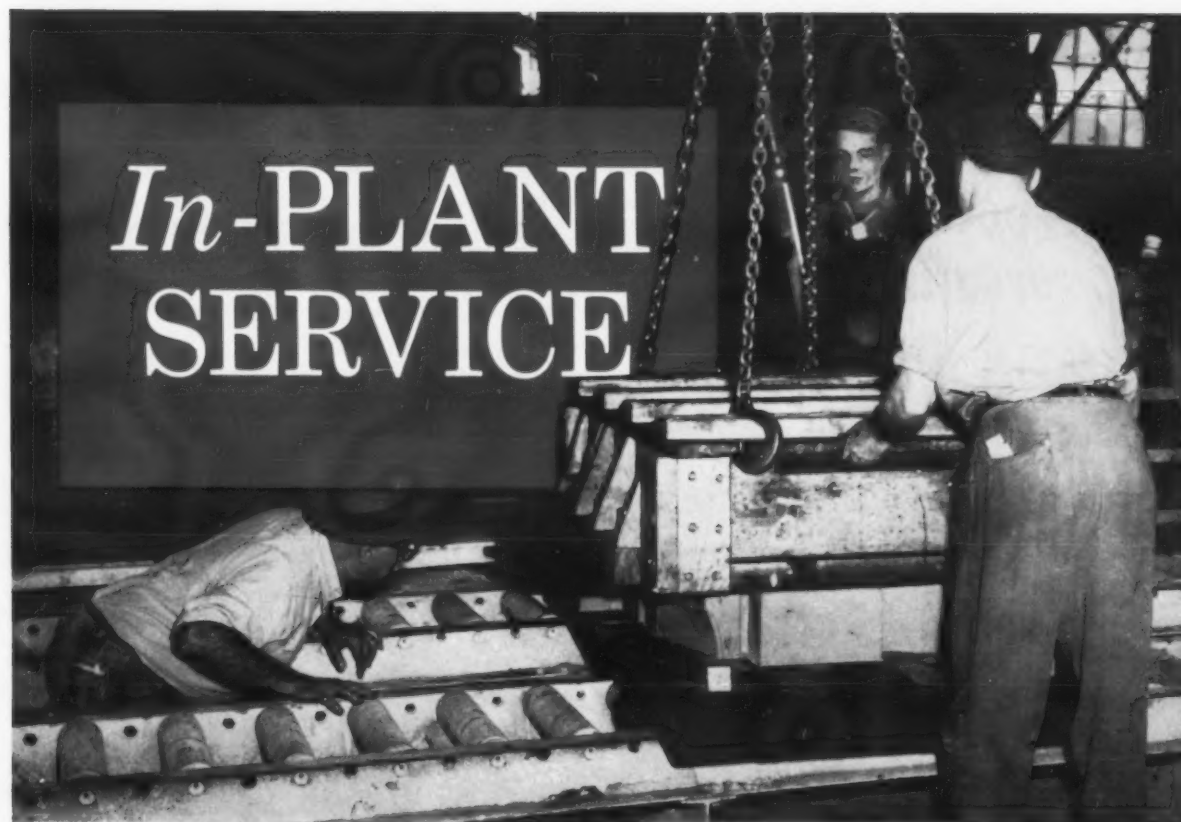


THE HANNA FURNACE CORPORATION
Buffalo • Detroit • New York • Philadelphia
Merchant Pig Iron Division of

NATIONAL STEEL CORPORATION



Circle No. 979, Page 7-8



In-PLANT SERVICE

BASIC REASON FOR BIG SAVINGS IN 270 FOUNDRIES

KOLD-SETTING Binder will produce optimum results when the installation is engineered by a qualified specialist. That is why we maintain "in-plant" service.

There are now 270 foundries using KOLD-SET to produce better castings at lower costs. The average reported savings is in excess of 40%. Each of these foundries was "started up" with the aid of one of our KOLD-SET engineers. Equipment was studied and evaluated—then, recommendations were made on how

KOLD-SET could be adapted to produce best results. The KOLD-SET man stayed with the installation during the early stages and remains on call if further services are required. Periodic service calls further assure our customers of maintaining production.

If you are wondering how KOLD-SETTING Binder will work—a KOLD-SET man will be glad to study your processing and offer recommendations without obligation.

Write or phone!

KOLD-SET
THE ORIGINAL COLD-SETTING BINDER
G. E. SMITH, INC.
245 Washington Road Pittsburgh 16, Pa.
Warehouses Stocks in Chicago, Boston, Detroit, Philadelphia

Kold-Set is Patented
in the United States

new

KOLD-SET **ZIRCON WASH**

Produces Better Castings because:

1. Controlled viscosity
2. Deep Penetration
3. Uniform Film Thickness

Write for bulletin.

cluded in this reprint of a talk delivered before the Atomic Energy Management Conference in Chicago. *Beryllium Corp.*

Circle No. 878, Page 7-8

Tensioning chart . . . for power hack saw blades made of laminated cardboard, 8-1/2x11 in., claimed to improve the performance of any blade. Two tables: one gives torque wrench readings for different blade combinations, the other shows the Wachs method. *Wachs Co.*

Circle No. 879, Page 7-8



Molten metal handling . . . equipment for all types of metal and operations featured in 72-p catalog. *Industrial Equipment Co.*

Circle No. 880, Page 7-8

Airless abrasive blast cleaning . . . finishing, and shot peening have been incorporated into 28-p handbook of ideas utilizing this method. Over 50 case histories are included covering applications such as; cleaning castings, deflashing plastic moldings and descaling. Company's machines are also described. *Wheelabrator Corp.*

Circle No. 881, Page 7-8

High temperature insulating materials . . . of spun mineral wool are covered in an illustrated, two-color booklet listing characteristics and specifications including thermal characteristics of company's two wide temperature range insulations. *Baldwin-Hill Co.*

Circle No. 882, Page 7-8

Steel shop equipment . . . presented in 8-p catalog illustrating and describing work benches, utility carts, tool stands and other units. *Borroughs Mfg. Co.*

Circle No. 883, Page 7-8

Fork lift truck . . . circular describes complete operating and maintenance features of model available. Points out how peak maneuverability has been incorporated through exclusive rear-wheel drive and by recessing the

mast between load wheels. Offered in capacities 100-2500 lb with 24-volt electrical system. *Lewis-Shepard Products, Inc.*

Circle No. 884, Page 7-8

Precision metal finishing . . . catalog, 24-pp, explains mechanical barrel-finishing methods. The story of how process can be applied to grinding, deburring, descaling, polishing and coloring of metal parts; contains special information for process engineers. *Roto-Finish Co.*

Circle No. 885, Page 7-8

Fork-truck . . . 4-p folder describes 3000-lb capacity, electric-powered fork truck. Highlighted with illustrations of truck designed for fast operation where congested working conditions or limited headroom are factors. Design and application included. *Elwell-Parker Co.*

Circle No. 886, Page 7-8

Continuous mixing diagram . . . showing an inexpensive way to properly condition green sand with emphasis on dry premixing and uniform sand properties. *Pekay Machine & Engineering Co.*

Circle No. 887, Page 7-8

Centrifugal casting of bronze and copper . . . parts is the subject of a well-illustrated booklet. Includes description of technique, chart showing alloys available with specific characteristics, illustrations of typical castings and facilities and engineering services. *American Brake Shoe Co.*

Circle No. 888, Page 7-8

Rare earths . . . and their metallurgical applications, both ferrous and non-ferrous, are discussed in abstract form in 46-p publication. Applications covered include improving cast iron properties, alloying stainless steels, and alloying additions to non-ferrous alloys. *Davison Chemical Co.*

Circle No. 889, Page 7-8

Coil induction melting furnace . . . for melting most types of non-ferrous metals described in pamphlet which lists advantages and applications as well as presenting line drawings, side and top views, of the unit. Folder covering complete line of 60-cycle induction melting furnaces also available. *Ajax Engineering Corp.*

Circle No. 890, Page 7-8

Infrared uses . . . in industrial temperature measurement and control systems form part of a 16-p report. *Servo Corp. of America.*

Circle No. 891, Page 7-8

Belt-driven ventilating units . . . with either forward curve wheels or backward blade non-overloading wheels



GUARANTEED SAVINGS

Now you can change to "SEMI-STEEL" abrasives and get a WRITTEN GUARANTEE from Metal Blast that you'll cut cleaning costs — no matter what steel abrasive you're now using! Reports from foundries using "SEMI-STEEL", plus our own laboratory tests, have convinced us that we can definitely guarantee savings in cleaning costs, over any other steel abrasive on the market.

"SEMI-STEEL" is a newly developed abrasive with steel shot characteristics. It is produced by an entirely new process, so efficiently, that it can be sold at malleable shot prices! "SEMI-STEEL" is manufactured as shot and grit, to S.A.E. specifications. Its performance compares so favorably to that of regular, high grade steel shot that, considering its extremely low price, you can't help but reduce your cleaning costs.

FREE LAB TEST

We invite you to send us a sample of your present steel shot (at least 200 grams). We'll run a test on it, against "SEMI-STEEL", and report the results. Or, we'll gladly send a sample of "SEMI-STEEL" for testing in your own lab. (Give size required.) Either way, you'll get welcome proof of "SEMI-STEEL" savings!

So, why continue paying high prices for steel shot cleaning? Write for more information on "SEMI-STEEL" — send in your sample or request our sample for testing. Take this first step toward savings, right now!

"SEMI-STEEL"
SHOT AND GRIT

\$155 per ton
in 50 or 100 lb. bags

METAL BLAST, INC.

675 EAST 87th STREET • CLEVELAND 3, OHIO

THE LARGEST INDEPENDENT MANUFACTURER OF ABRASIVES — OVER 2500 TONNAGE PER YEAR

Circle No. 981, Page 7-8

covered in bulletin. Complete performance tables, engineering data, selection and installation information, and full specifications on 12 basic ventilation fans included. *General Blower Co.*

Circle No. 892, Page 7-8

Offhand belt finishing . . . selection chart on durable card stock 15x27 in. Designed to be hung in tool rooms and work areas. Copies available without charge. Gives requirements for belt finishing—material, operation, abrasive belt to be used, grit, belt speed, lubricant, type and hardness

of contact wheel and how they work. *Behr-Manning Co.*

Circle No. 893, Page 7-8

Materials handling . . . techniques featured in 16-p color presentation. Case histories of successful application of mechanized materials handling in a wide range of industries. Subjects discussed are palletless handling, and solutions to multi-level problems. *Lewis-Shepard Products, Inc.*

Circle No. 894, Page 7-8

Hand truck . . . two-wheel and platform, colorful brochure issued. Six pages provide construction features,

applications and basic specifications, standard line of lift-jack platform trucks, all-wood platform trucks, dollies and all-steel two-wheel hand trucks. *The Fairbanks Co.*

Circle No. 895, Page 7-8

Business growth . . . according to a financing specialist, depends on three basic requirements listed in new booklet. Analyzes requirements for growth and outlines plan comprised of five basic features. *Commercial Factors Corp.*

Circle No. 896, Page 7-8

Flexible wiring conduit . . . data and specification sheet lists advantages and uses of galvanized metal tubing conduit. Samples available on request. *Electri-Flex Co.*

Circle No. 897, Page 7-8

Industrial stationary compressors . . . described in bulletin stressing how rotary design contributes to true multiple stage compression. Also contains specifications for compressors and accessories. Compressors available in 20-40 hp sizes, operating at 125 psi, and freedom from vibration. *Davey Compressor Co.*

Circle No. 898, Page 7-8

Grinding wheels and segments . . . are shown, uses described, and sizes given in colorful bulletin. *American Emery Wheel Works.*

Circle No. 29, Page 7-8

Conveyor chain . . . bulletin available containing dimensional prints of various sizes, with or without attachments. Includes many installation photographs showing use of its engineered conveyor chain in slat conveyors, pusher bar boosters, and as side chains for open types of belting in metal cleaning and processing machines. *Alvey-Ferguson Co.*

Circle No. 899, Page 7-8

Oxidation-reduction potential . . . measured, indicated and recorded by instrument presented in catalog. Electric, electronic or pneumatic control function may be added for automatic control of batch or continuous processes. *Fischer & Porter Co.*

Circle No. 900, Page 7-8

Electrode-air torches . . . definition, and uses disclosed in nine case histories presented in booklet form. All case histories include torch model, current used, electrode size, speed, and air pressure. Data sheets also available. *Arcair Co.*

Circle No. 901, Page 7-8

Reference chart . . . allows reader to cross-reference company's brazing alloy number with other two leading lines of brazing alloys. Company is

a new manufacturer of brazing alloys and flux. *American Brazing Alloys Co.*

Circle No. 902, Page 7-8

Sand handling system for foundries . . . outlined in bulletin which contains detailed lined drawings of 2, 4, 6, and 8-station units. Benefits and operational procedures listed. *Jeffrey Mfg. Co.*

Circle No. 903, Page 7-8

Electronic control devices . . . catalog contains prices, features, wiring diagrams, dimensions and application information for complete line of control equipment. Includes descriptions of starters, contactors, relays, solenoids, limit switches, pilot devices, and also other controls. *General Electric Co.*

Circle No. 904, Page 7-8

Silicon power conversion units . . . designed for general purpose industrial applications such as power supply for cranes, elevators, and tools, requiring 250-volt current to 600 kw. Four-p bulletin uses photos, graphs, and charts to illustrate features of these units. *General Electric Co.*

Circle No. 905, Page 7-8

Brushes for rotating electrical equipment . . . are listed in 24-p catalog which includes specifications covering equipment type, volts, brush numbers and sizes. Sketches showing how to determine brush bevel angle also included. *Ohio Carbon Co.*

Circle No. 906, Page 7-8

Silica sand production . . . graphically demonstrated in brochure containing series of pictures taking the reader from the sand deposit, through refining processes, to delivery of 24 grades of silica sand to customers. Also lists grade numbers and their fineness. *Wedron Silica Co.*

Circle No. 907, Page 7-8

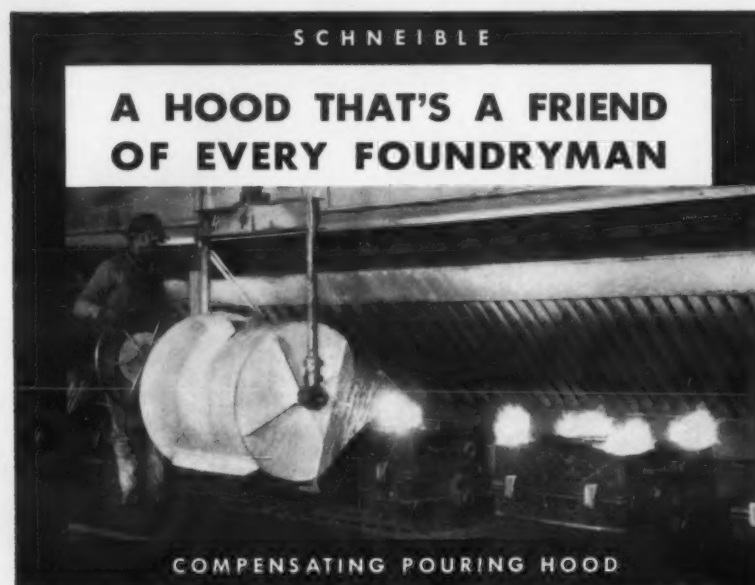
Grinding wheels . . . illustrated in bulletin including tables of wheel types and sizes and markings applicable for high speed steel cutter and drill sharpening. *Robertson Mfg. Co.*

Circle No. 908, Page 7-8

Industrial weighing . . . load measurement, and recording instruments are described in three new bulletins. Lift truck weight indicators available in 2000-50,000 lb capacities said to have accuracy of 2 per cent up to 4000 lb, 1 per cent or better on heavier models. *Martin-Decker Corp.*

Circle No. 909, Page 7-8

Conveyor and elevator belt pulleys . . . bulletin including specifications, features and detailed price lists. Pulleys are claimed to be self-cleaning



Clean, fresh air summer and winter, is what you enjoy with a Schneible Compensating Air Hood.

This hood includes air direction controls which allows efficient dust and fume collection without sacrifice of worker comfort.

Many sizes and capacities are available for both jobbing and production foundries.

Our representative will be glad to discuss your problem with you, or wire direct for complete details.

SCHNEIBLE

CABLE ADDRESS FOR
FOREIGN INQUIRIES: CBSCO
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ELEX S. A., ZURICH, SWITZERLAND

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REFER TO SWEET'S FILE NO. 16/SC
P.O. Box 296, Roosevelt Park Annex—Detroit 32, Michigan

Name _____
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Company _____
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City _____ Zone _____ State _____

SERVING FOUNDRYMEN THE WORLD OVER

Circle No. 982, Page 7-8

and to prevent belt misalignment.
Van Gorp Mfg. Inc.

Circle No. 910, Page 7-8

Foundry equipment . . . catalog, hard cover, contains illustrations and specifications of foundry flasks, flask accessories, wheelbarrows, carts, trucks, and also explanation of flask symbols.
Sterling Wheelbarrow Co.

Circle No. 1, Page 7-8

Thermometers . . . for measuring temperatures of foundry sand at various depths and also for checking temperature of molten metals are described in data sheet. Company's dynamometer is useful in weighing molten metal and testing torque, tension, traction and compression.
W. C. Dillon & Co.

Circle No. 2, Page 7-8

Horizontal vibrating screens . . . are the subject of bulletin. Discusses design and construction features, diagramming installation methods along with floor mounting arrangements for the screen. Carries size and dimension tables on cable-suspended and floor-mounted units.
Allis-Chalmers Mfg. Co.

Circle No. 3, Page 7-8

Grinding wheel handbook . . . devotes 16 pp to features and specifications of snagging and grinding wheels, standard wheel marking chart, grinding costs, proper handling of grinding wheels, proper maintenance, and safety rules.
Peninsular Grinding Wheel Sales Corp.

Circle No. 4, Page 7-8

Reference chart . . . which tells special crayons to use in marking surfaces of industrial materials, from glass and china to iron and steel. Made of heavy stock paper protected with varnish, and punched to fit in three-ring notebook, the chart includes several dozen kinds of crayons listed according to suitability for such surface conditions as: cold, warm or hot to above 1200 C; rough, slick, glazed, laminated or coated.
Joseph Dixon Crucible Co.

Circle No. 5, Page 7-8

Heavy-duty fork lift trucks . . . featured in 6-p illustrated folder listing specifications. Units available in six different models with load-carrying capacities of 8000-40,000 lb. Also available are 11 new 4-p specification sheets covering complete range of 26 capacities. These sheets include profile diagrams showing overall dimensions and turning radii.
Towmotor Corp.

Circle No. 6, Page 7-8

Vibratory feeder catalog . . . 32 pp, includes complete data and specifications for 13 standard vibratory feed-

LARGE...



OR SMALL...

there is a grade of **PENN-SAND** for every type of core

Regardless of size, metals poured or core process used, we can supply a grade of Penn-Sand to meet your most exacting requirements.

Whether you are pouring steel, gray iron or non-ferrous metals—whether you use core oil, bentonite, cold-set binders, the CO₂ process or make shell cores—Penn-Sand will help you produce better cores at lower cost.

The secret is Penn-Sand's perfect uniformity—which allows you to standardize your mixes. You save the time and money that would normally be spent changing mixes every time a car of sand is received.

Triple washing, multiple screening and rigid testing before shipment are responsible for the perfect uniformity of each grade of Penn-Sand—a uniformity maintained shipment after shipment.

CORE SAND
MOLDING SAND
SHELL-MOLDING SAND
Q-ROK SANDBLAST SAND
SUPERSIL SILICA FLOUR

PENN SAND

THE SURE START TO A PERFECT FINISH

Pennsylvania Glass Sand



The world's leading producer of pure crystalline silica

Sales Offices: 375 Park Ave., New York, N. Y. • Two Gateway Center, Pittsburgh 22, Pa. • 8000 Bonhomme Ave., St. Louis 5, Mo. • 721 Enterprise Bldg., Tulsa 3, Okla.
Plants: NEWPORT, N. J. • MAPLETON, PA. • McVEY TOWN, PA. • BERKELEY SPRINGS, W. VA. • JACKSON, O. • PACIFIC, MO. • KLOWBIRE, MO. • MILL CREEK, OKLA.

Circle No. 983, Page 7-8

May 1958 • 187

Now! A PORTABLE PNEUMATIC CONVEYOR

(needs no Pit)

VISIT
BOOTH Nos.
1648 and 1747
American Foundry
Convention
CLEVELAND
May 19-23

Automatically TRANSPORTS FOUNDRY SANDS Faster...at low cost

- EASY TO INSTALL
- LOW ORIGINAL COST
- LOW MAINTENANCE

MODEL 50. Five cubic feet capacity transporter with loader in raised position.

CUTS MATERIAL HANDLING COSTS for small Foundries

Even a small foundry can increase production and save costly man hours with WHIRL-AIR FLOW Pneumatic Conveyor System. This system transports all types of foundry and core room sands, mixes and other dry granular materials.

The portable WHIRL-AIR FLOW System, illustrated, can be moved into your plant as a complete unit, ready for operation, with no major engineering or structural changes needed.

WHIRL-AIR FLOW delivers sand mixes which are well aerated and fluffed, without moisture loss. A spiral air flow is maintained directionally throughout the pipe line for efficient material handling and reduction of abrasive wear on seamless tubing.

The Transporter, loaded from the source, sends sand under air pressure in a smooth, whirling flow into the pipe line. Booster Fittings at proper intervals on the line maintain the directional spiral and hold sand in suspension. Transfer switches and line flexibility permit delivery of material to any location. A dust-tight cabinet houses the push-button control equipment. Special design insures low wear and long life of the Receivers, as well as all other equipment. Addition of Transfer Switches and Receivers, as needed, provides for plant expansion.



WHIRL-AIR-FLOW CORP.

Federal 9-0231

200 23th Avenue S. E., Minneapolis 14, Minnesota



LOADING TRANSPORTER FROM MULLER

Showing loader lowered in loading position receiving from Muller. When filled, loader is raised over transporter and dumped as seen in upper photo.

TRANSPORTER is sealed after loading. Three inlet manifolds admit air into the chamber through removable jets which distribute the air in a downward directional spiral carrying material in a smooth whirling flow from the outlet cone into the pipe line.

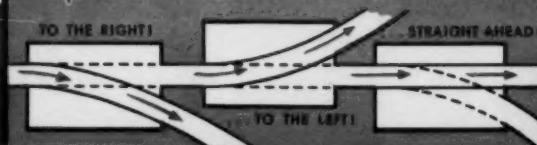
TRANSFER SWITCHES and pipe line flexibility permit delivery of material to any location. Work stations and storage can be located where desirable. Each transfer switch provides two-way distribution as illustrated below. Add switches to serve additional stations as foundry grows. These Whirl-Air-Flow switches are simple, practical design. Special reinforced rubber tubing and rugged construction assure long maintenance-free operation.



TRANSPORTER SIZES

MODEL 50	5 Cu. Ft.
MODEL 90	9 Cu. Ft.
MODEL 180	18 Cu. Ft.

WRITE TODAY for additional information on how the WHIRL-AIR-FLOW System can save dollars in your plant, or call for representative.



ers, three hydraulic and pneumatic feeders, and elevator feeders. Describes and illustrates several other specially engineered models. *Syntron Co.*

Circle No. 7, Page 7-8

Epoxy resin tooling plastics . . . presented in 4-p, illustrated bulletin which outlines the basic operations that are carried out in the preparation of plastic tools. Manufacturer claims that tools made from epoxy plastics are lighter in weight; have outstanding permanence; and, by avoiding elaborate machining, cut costs considerably. *Furane Plastics, Inc.*

Circle No. 8, Page 7-8

Stainless steel fabrication . . . methods and practices are covered in detail in a 386-p book containing more than 140 photographs, 120 charts and graphs, and about 200 diagrams. In addition, includes many reference tables and a detailed index. *Allegheny Ludlow Steel Corp.*

Circle No. 9, Page 7-8

Electropolishing . . . in the metallographic laboratory, technical article featured in metal digest booklet. Includes specifications and features of electro-polishing unit. *Buehler Ltd.*

Circle No. 10, Page 7-8

Wet dust collector . . . operating fact sheet. Features include no moving parts, nozzles or pumps. Discharge air free of entrained water. *Wheelabrator Corp.*

Circle No. 11, Page 7-8

Hydraulic and air cylinders . . . described in two bulletins with features of many models pointed out with line drawings. Cylinders develop force up to 2000 psi. *Teer-Wickwire & Co.*

Circle No. 12, Page 7-8

Shell core machine . . . said to produce shell cores excelling in permeability, collapsibility, accuracy and easy shakeout described in attractive brochure. Includes picture sequence showing proper operation and large photograph on which features are pointed out in detail. *Dependable Pattern Works.*

Circle No. 13, Page 7-8

Which Core Process . . . reprint, 6 pp, discusses four major coremaking processes with a comparison of the advantages and the disadvantages of each. *Archer-Daniels-Midland Co.*

Circle No. 14, Page 7-8

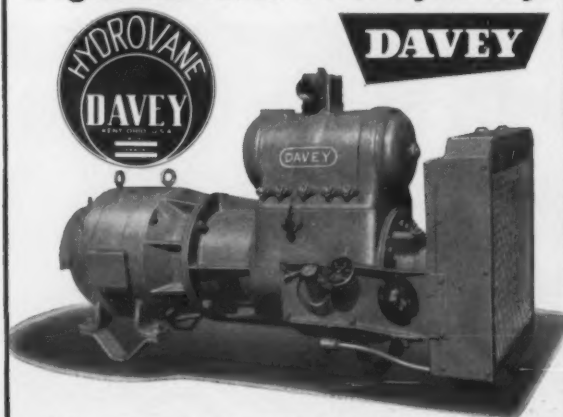
Birth of gray iron castings . . . related in technical, colorful, 20-p book.

Circle No. 984, Page 7-8

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...get the facts before you buy!



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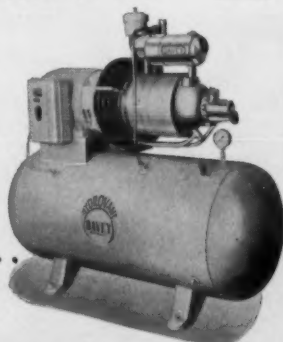
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Circle No. 985, Page 7-8

Reviews essential role of gray iron in modern manufacturing. Relates production of gray iron castings into two basic raw materials, pig iron and foundry coke. *Pittsburgh Coke & Chemical Co.*

Circle No. 15, Page 7-8

Numerical drilling control system . . . for drill presses described in brochure. Automatic drilling of a typical part is illustrated step by step and a cost comparison with hand drilling is made. *Electronic Control Systems Div., Stromberg-Carlson Co.*

Circle No. 16, Page 7-8

Core bonding study . . . describes efforts that led to discovery of a pitch for core binding that produces bond of uniform strength. Discusses and illustrates bond structure and bond fracture. Honeycomb structure of uncontrolled pitch disclosed. *Penn-Rill-ton Co.*

Circle No. 17, Page 7-8

Job evaluation technique . . . in small industry summarized in newsletter. Involves four main steps: analyzing the job, writing up job sheet, making the classification, and pricing job. States that evaluation is not an exact science but a logical and methodical way of guiding judgements. Of interest to personnel management especially. *Small Business Administration.*

Circle No. 18, Page 7-8

Ceramic gating components . . . catalog covers all standard cores, splash cores, elbows and tubes. Dimensions, standard package and weights tabulated. Easily read graph presents the rates of metal delivery through every size strainer cores in lb as well as cubic in.-per-sec as function of head pressure. *Universal Clay Products Co.*

Circle No. 19, Page 7-8

free films

■ Motion pictures and other visual aids based on foundry processes and supplies are also yours *for the asking*. These films are suggested for formal or informal training groups. The owners of films in this column will send booking request forms to MODERN CASTINGS readers who circle the appropriate number on the Reader Service card (page 7-8).

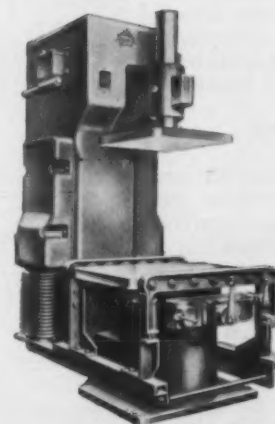
Aluminum on the March . . . 28 min, color film. Deals with uses of aluminum in every phase of modern living. Camera roves from bauxite mines to rolling mills, showing how aluminum is mined, reduced from powder to metal, cast, rolled, extruded, pressed. *Association Films, Inc.*

Circle No. 20, Page 7-8

Pure and Simple . . . 19 min film gives practical solutions to problems of in-

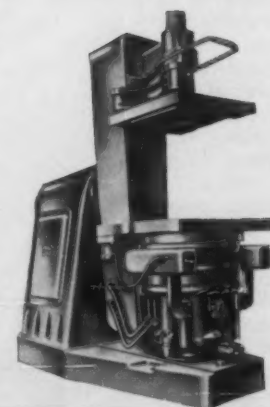
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Circle No. 986, Page 7-8

F1462

dustrial waste and water conservation. Specialized equipment portrayed in action and case histories dramatized. *Link-Belt Co.*

Circle No. 21, Page 7-8

Recorded technical talks . . . price list available. Lists and describes 45 tape recordings of talks about foundry technology by top men of the castings industry. *MODERN CASTINGS.*

Circle No. 22, Page 7-8

Photoelastic Studies of Joined Section in Castings and Weldments 16 mm, black and white, 27-min film reveals photoelastic properties of both the cast and welded corner sections, and compares results with actual fatigue test specimens. *Steel Founders' Society of America.*

Circle No. 23, Page 7-8

Zinc Controls Corrosion . . . 16 mm color sound film, 38 min, shows the fundamental nature of corrosion of metals and how zinc coating controls such corrosion. Includes a trip into steel mill producing galvanized steel. *American Zinc Institute, Inc.*

Circle No. 24, Page 7-8

Here's Your Worksaver . . . 16 mm, color, 15 min. Sound film covers materials handling in foundries, with emphasis on self-loading electric lift trucks. *Yale & Towne Mfg. Co.*

Circle No. 25, Page 7-8

Heat Treatment of Aluminum . . . Film I; 16 mm, black and white, 19 min. Film II; 16 mm, black and white, 24 min. Sound film outlines the purpose of heat treatment, microstructure changes, and aging of effects of heat treatment on physical properties of aluminum. *United World Films, Inc.*

Circle No. 26, Page 7-8

The Invisible Shield . . . Color sound film, 16 mm, 23 min. Shows modern foundry equipment in applications of raw material handling, cupola charging, melting, hot metal distribution, sand preparation, molding, pouring, shakeout, cleaning, inspection and shipping castings. It also explains the dust and fume control in operations where it applies, and building ventilation balance. *Claude B. Schneible Co.*

Circle No. 27, Page 7-8

Ultrasonic Inspection . . . 16 mm, sound color film, 10 min. Demonstrates the latest techniques in ultrasonic testing of raw stock, finished parts and plant equipment. Also describes the latest recent developments in immersion testing, involving automatic recording of testing results. *Sperry Products, Inc.*

Circle No. 28, Page 7-8

MORE WORK EVERY HOUR

through these exclusive Yale features . . .

- Yale Torque Transmission (fully automatic)
- 45° ground-level bucket tipback
- Safety-curve arms
- Accelerates to operating speed of 8 mph. in 3.5 seconds—to a speed of 13 mph. in 5.5 seconds
- 6 foot dumping clearance
- Sealed brakes
- Front and rear operating lights

At last—a tractor shovel designed especially for industry! Whether you handle bulk chemicals, sand, gravel, scrap or raw materials, you'll get more productive work at less cost per work unit with this new concept in a tractor shovel.

Yale designed it for tight areas—built it compact (only 117" overall length) so that it can maneuver in any aisle wide enough for a wheelbarrow. *Accelerates to an operating speed of 8 mph. in 3.5 seconds and to a top speed of 13 mph. in 5.5 seconds.* Exclusive Yale Torque Transmission (fully automatic) permits quicker, smoother starting, eliminates shifting, provides more

power under load conditions—in a word, *speeds cycle operations.* This extra speed, plus the greatest carrying capacity of its class (full 2500 lbs.) means *up to 25% more work per hour.*

Yale's loader-linkage design offers unique advantages. Exclusive 45° *Ground-Level Tipback* insures the ultimate in loading action—and a grade-level carrying position to minimize spillage. Exclusive 6 foot *Dumping Clearance* is highest on any model of similar wheelbase. Bucket is *Automatically Self-Locating.* Operator merely lowers from full dump-position to ground-level—bucket automatically returns to digging position.

a product of Yale's integrated design—these engineering advances are standard features

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- Sealed hydraulic system—keeps dirt out
- Pre-cleaner—air cleaner combination
- Extra strong heavy welded steel frame—greater safety, longer life
- Automatic bucket return to digging position
- Carrying capacity of 2500 lbs.—bigger load capacity
- Short wheel base—minimum turning radius
- Sealed generator and distributor
- Balanced weight distribution
- Maximum speeds up to 13 mph.



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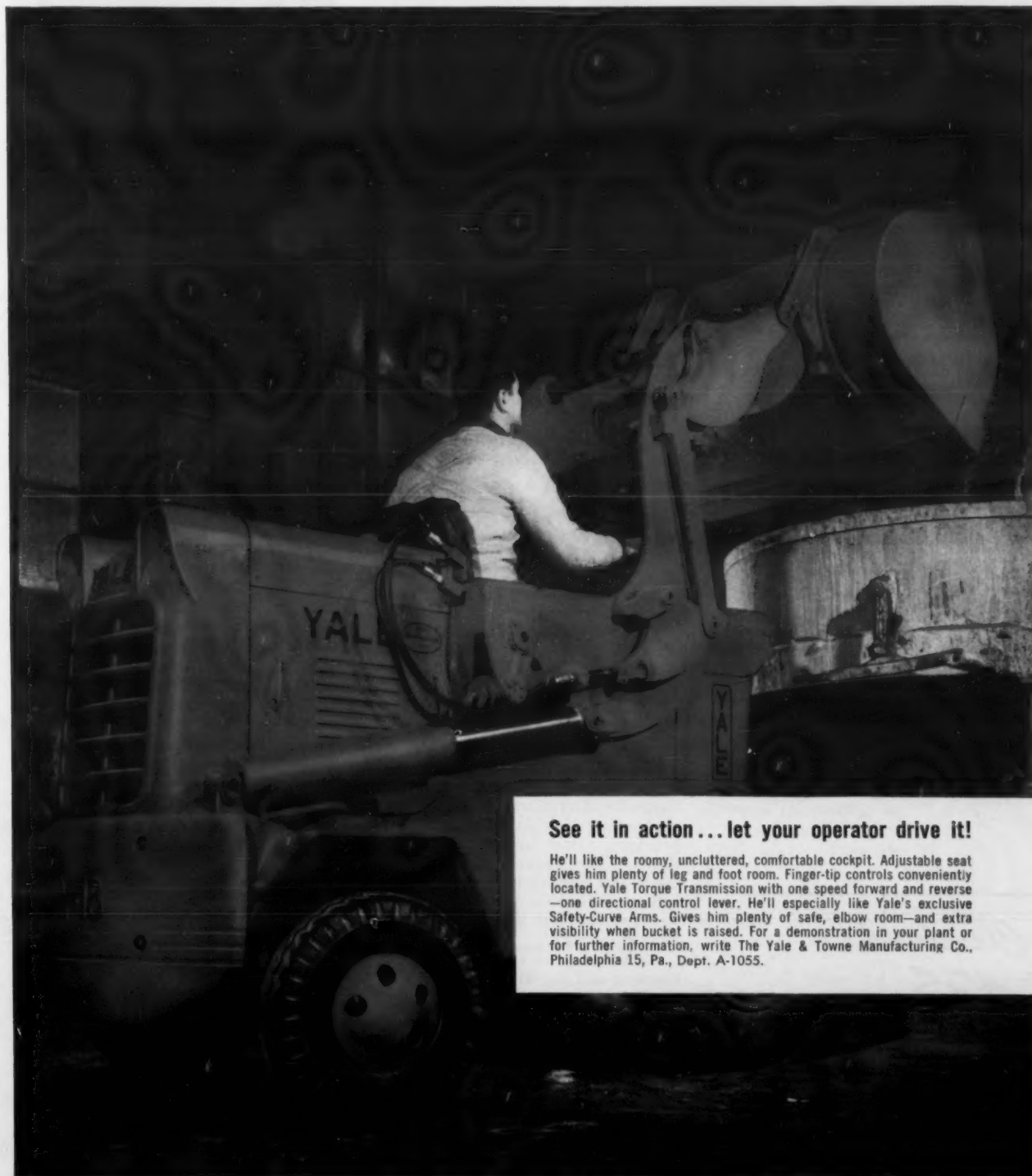
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Circle No. 987, Page 7-8

YALE introduces...the INDUSTRIAL tractor shovel

DESIGNED TO GIVE YOU 25%



See it in action...let your operator drive it!

He'll like the roomy, uncluttered, comfortable cockpit. Adjustable seat gives him plenty of leg and foot room. Finger-tip controls conveniently located. Yale Torque Transmission with one speed forward and reverse—one directional control lever. He'll especially like Yale's exclusive Safety-Curve Arms. Gives him plenty of safe, elbow room—and extra visibility when bucket is raised. For a demonstration in your plant or for further information, write The Yale & Towne Manufacturing Co., Philadelphia 15, Pa., Dept. A-1055.

She's Fascinated by Fiery Wonders of Foundry World

by Olive Gilbert*

■ I had seen men pouring molten metal on television and in movies, but now I was about to see the real thing; they were already pouring as I walked into the foundry.

Noise and Fire

It was like walking into another world, a world of noise and fire. The furnace was an inferno from which molten liquid spewed into a huge caldron-type bucket. I watched the liquid fire, fascinated; here was a color I had never seen before. It was white and clear but not transparent. It was like a flowing mirror, beautiful—and terrible. Heat hit my face, forcing me a step or two backward. I watched the liquid, pure and clean, forgetting the dirty surroundings until grit crunched beneath my feet.

The furnace was righted and the fiery stream stopped. Slowly, the bucket rose and moved overhead on tracks to the mold. I cringed, what if it should break loose; I wondered how many times this had happened. Apparently I was alone in my fear; the men moved with unconcern about their work. Later I learned my imagination had been running riot—such things just don't happen.

Wants X-Ray Vision

The bucket halted over the mold, valves were turned, and metal poured into the openings. Pellets of fire bombarded the men—they ignored them. I longed for x-ray vision enabling me to see into that mold; liquid feeling its way through every opening, pushing on, seeking out the tiniest crack.

The flow of metal slowed to a tiny stream. The bucket swung back and moved out of the way, dribbling a pathway of molten pellets across the floor; then it dipped again, filling another bucket with its beautiful contents. This was used to complete the filling of the mold. Odors rose, and changed. First the smell of hot wood, then strange, undefined odors. Gases exploded in occasional sharp claps of noise. Men worked quickly, scattering buckets of sand-like material over the top of the mold, which smoldered, belching up smoke. Then with minor explosions it cascaded sparks into oblivion around the men.

Billows of smoke puffed and fumed out of holes, then flared into white, artificial-looking flames. The smoke changed colors as it drifted, hanging restless against the ceiling. The bucket moved away—it was over.

*Former secretary to E. J. McAfee, Retired, Puget Sound Naval Shipyard, Bremerton, Wash.

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at the 62nd AFS
Castings Congress & Exhibit*

*May 19 thru 23
See us in Booth 1712*

Circle No. 988, Page 7-8

Wheelabrator Announces a \$100,000 Grant for Foundry Education at F.E.F. Meeting

■ The foundry industry will benefit for many years as the result of a new scholarship program unveiled at the Foundry Educational Foundation's 11th Annual College-Industry Conference held in Cleveland in March.

Wheelabrator Corp. president, J. F. Connaughton announced that the Wheelabrator Foundation is providing a \$100,000 grant to promote graduate study by young scientists, engineers, and prospective management personnel with interests in the foundry industry.

Fifty fellowships of \$1500 each are to be distributed during the next ten years. The remaining \$25,000 is to be used by F.E.F. for fellowships, scholarships or other educational purposes.

Who is Eligible

Applicants must not be more than 28 years of age. They will include:

1) Senior undergraduate students who are or have been registered with F.E.F.

2) Present graduate students who are or have been registered with F.E.F.

3) Men in and returning from the military service who were F.E.F. registrants in college or who were employed in the foundry industry prior to entering the service.

4) Men employed in the foundry and allied industries.

The Wheelabrator Foundation was established in 1953 to provide a planned, continuing program of support for educational, religious and other charitable causes. Nearly \$100,000 has been contributed since its inception.

Commenting on the program, O. A. Pfaff, chairman, Wheelabrator Corp. board of directors pointed out the necessity of higher education in providing future leaders for the industry, "Youth education in the sciences and engineering, and in marketing and business management, may well become the life blood of the foundry industry."

Dedicated to an extensive program fostering and improving education in foundry science, engineering and operation, the F.E.F. was organized in 1947 by these six organizations:

- 1) American Foundrymen's Society,
- 2) Foundry Equipment Manufacturers Association,
- 3) Gray Iron Founders' Society,
- 4) Malleable Founders' Society,
- 5) Non-Ferrous Founders' Society and



J. F. Connaughton, right, Wheelabrator Corp., presents company's Foundry Educational Grant to F.E.F. president, C. V. Nass in Cleveland.

6) Steel Founders' Society of America.

The foundation's current program encompasses scholarship opportunities at 17 F.E.F. affiliated universities throughout the nation. The Wheelabrator-F.E.F. fellowships mark the first step in the organization's plans for support of graduate study.

New Officers

Newly elected F.E.F. president, F. X. Bujold, Foundry Div., Ford Motor Co., Dearborn, Mich., succeeds C. V. Nass, Beardsley & Piper Div., Pettibone Mulliken Corp., Chicago. As immediate past president, Nass remains on the executive board.

The new F.E.F. vice-president is F. G. Steinebach, Penton Publishing Co., Cleveland. W. B. Bishop, Archer-Daniels-Midland Co., Cleveland, was named secretary; and E. M. Knapp, Ferro Machine & Foundry, Inc., Cleveland, was elected treasurer. Previously, Knapp was secretary-treasurer.

Speakers at the conference included C. J. Freund, Dean, College of Engineering, University of Detroit; and Dr. C. E. Williams, president, Clyde E. Williams & Co., Columbus, Ohio.

In his talk, "The Foundry Industry's Needs—from Craftman to Scientists," Freund concluded that any foundry, or indeed, any industry that does not 1) follow closely scientific research; 2) conform to scientific progress or 3) merchandise intelligently and energetically, is "already on the floor and hearing the count of five or six."

Williams, speaking on "The Foundry Industry in the New Technological Age," told F.E.F. members

that "Automation could be one of the biggest surprise packages in the technological grab bag . . ." foundries will have to automate to avoid obsolescence of facilities. He called on foundries to prepare to handle exotic metals such as nickel, chromium, cobalt, columbium, molybdenum, tungsten, titanium and stainless steels; to equip their plants to melt and cast in vacuum or inert atmospheres; and to produce products to exacting standards of precision.



New F.E.F. officers, President F. X. Bujold, left; and Vice-President F. G. Steinebach.

The "committee" discussion technique was employed in a panel discussion, "Engineering Education in Cast Metals for the Future."

The panel was moderated by W. B. Bishop, Archer-Daniels-Midland Co., Cleveland, and included C. F. Walton, Gray Iron Founders' Society; J. H. Lansing, Malleable Founders' Society; H. F. Scobie, Non-Ferrous Founders' Society; and C. W. Briggs, Steel Founders' Society of America.

"Ideal" Education

Panel members offered their opinions regarding

1) the "ideal" engineering education for a prospective foundry engineer,

2) strong and weak points of engineering graduates now in the foundry industry,

3) the desirability of graduate training in cast metals and

4) what the "ideal" university foundry laboratory would include.

F.E.F. members broke up into small groups, discussed these points, and reported their conclusions or questions to the panel and group.

An additional panel discussion, "An Expanded F.E.F. to Meet the Needs of the Foundry Industry," was moderated by F. G. Steinebach, Penton Publishing Co., Cleveland. Panel members included M. J. Allen, American Steel Foundries, Chicago; T. T. Lloyd, Albion Malleable Iron Co., Albion, Mich.; W. Sicha, Aluminum Co. of America, Cleveland; and H. K. Dreher, Steel Founders' Society of America.



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Every foundryman must have a thorough knowledge of the sound principles of process control, coupled with basic scientific knowledge, to consistently turn out quality metal at lower costs.

It is to provide this information to the metal castings industry that the American Foundrymen's Society has issued the second edition of **THE CUPOLA AND ITS OPERATION**, a completely revised, enlarged reference book, divided into four primary sections: Operations . . . Equipment . . . Materials . . . Principles Related to Operations.

Latest developments, such as hot blast, basic lining for nodular iron and emission control are detailed in concise, easy-to-understand foundry terms. Other chapters such as refractories, principles of combustion and metallurgy have been greatly augmented or are presented for the first time.

Included in the 35 information-packed chapters are such vitally important subjects as: Calculating the Cupola Charge, Cupola Lining and Daily Maintenance, Coke Bed, Operating Techniques, Control Tests, Composition Control, Basic Cupola, Mechanical Charging Equipment, Forehearth-Ladles, Cupola Fuels, Refractories and Thermal Chemistry.

Casebound, this 300-page, 8½ x 11-inch book contains 328 illustrations and 54 tables.

Member Price . . . \$6.00

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Magnesium Technology Symposium

■ The Magnesium Association and the Society of Aircraft Materials and Process Engineers will sponsor a symposium discussing Magnesium Technology in the Missile Age. The program will be held June 4-5 at the Aeronautical Sciences Building, Los Angeles.

Of the 15 technical talks scheduled on the program, casting techniques will be covered in **Cast-in Inserts and Tubeless Passages in Magnesium Castings** by K. Sealander, Hills-McCanna, Chicago; **Design Engineering of Magnesium Castings** by G. H.

Found, Saginaw Bay Industries, Inc., 224 N. Water St., Bay City, Mich. and **Thin Wall Castings, Tolerances and Surface Finish as Useful Techniques** by Dr. F. J. Dunkerley, Rolle Mfg. Co., Inc., 3rd and Cannon Ave., Lansdale, Pa.

A Panel of Missilemen will discuss **Protective Finish Systems for Magnesium in Missiles**; **Uses of Magnesium on the Falcon Missile**; **Magnesium-Thorium Alloys in the Polaris Missile**; and **Magnesium Usage in the Vanguard**.

The Magnesium Association, P.O. Box 17391, Foy Station, Los Angeles 17, Cal. is accepting requests for free information on the detailed program.

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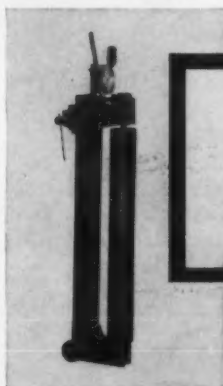
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Circle No. 990, Page 7-8

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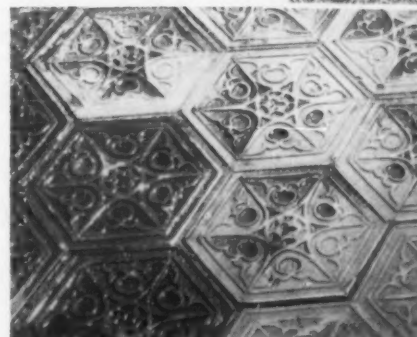
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Circle No. 991, Page 7-8

CAST IRON SIDEWALK Keeps 'em Guessing



Philadelphia's 57-ft stretch of cast iron sidewalk has been in use for 101 years.



Shoe leather has polished iron walk for 101 years but has not destroyed the fancy filigree.

Subject of considerable discussion and controversy among residents of the Seventh and Berks Streets vicinity, Philadelphia, (from small boys wearing roller skates, to industrial executives,) is this cast iron sidewalk.

Rumors surround the origin of the 101-year-old casting, which bears an elaborate hexagon design, and is 57 feet in length. One is that the builder was the late C. M. Schwab, the Bethlehem Steel magnate; and another concerns Miss Althea Carness, born in the house fronting on the sidewalk, who reportedly disliked children so much she had the bumpy sidewalk laid to keep them from roller skating there.

Schwab could not have built the sidewalk; he was born five years after the sidewalk was laid. Althea Carnell did not dislike children; she raised

three boys as wards, and was a pioneer in the movement to get playgrounds for children in crowded sections of the city. Moreover, she inherited the sidewalk.

Her father, Charles, is said to have cast the sidewalk in 1857, seven years before Althea's birth, to advertise the workmanship of his foundry at Fifth Street and Girard Ave.

The present occupant likes the iron sidewalk; snow melts faster than from concrete or brick, and it's easy to keep clean.

Judging from lack of wear and tear during the past 101 years of abuse from the heels and wheels of humanity, it will be more than a few years before funds are needed for repair and maintenance of the wear-resisting cast iron sidewalk at Seventh and Berks Streets.

Glossary of Gating and Riser Terms

Foundrymen sometimes misunderstand terms used in technical papers on the subject of Gating and Riser. MODERN CASTINGS is listing here some of the more common terms used in describing gating and riser systems so that we all "speak the same language."

BOTTOM RUNNING OR POURING - Filling of the mold cavity from the bottom by means of gates from the runner.

BRANCH GATE - Two or more gates leading into the casting cavity.

CHOKE - A restriction in the gating system for the purpose of keeping dirt dross or slag from entering the casting proper.

CORE GATE - Core used for forming a gate in the mold.

CORE SPLASH - A core generally used in the drag to restrain and guide molten metal as it enters mold, thereby preventing undue tendency toward washing mold surface.

CORE STRAINER - Baked sand or refractory disc with uniform size holes through its thickness used to control the discharge of metal from pouring basins or to regulate the flow of metal in gating systems of molds; also to prevent entrance of dross or slag into the mold cavity.

GATE - End of the runner in a mold where molten metal enters the casting or mold cavity; sometimes applied to entire assembly of connected channels, to the pattern parts which form them or to the metal which fills them, and sometimes is restricted to mean the first or main channel.

GATED PATTERNS - One or more patterns with gates or channels attached.

GATE FINGER - Gate used on thin castings to allow rapid filling of mold. It is wedge-shaped with thin edge divided vertically to produce several members or fingers. Metal flows into mold in several thin streams. Facilitates breaking gate from a thin or delicate casting.

GATE, HORN - A semicircular gate to convey a molten metal over or under certain parts of a casting so that it will enter the mold at or near the center; also used as a skim gate.

GATE, PENCIL - A series of small round gates entering the mold cavity from above and coming from a common pouring basin.

GATE, RING - A gate so formed that a number of small gates conduct the metal from a circular runner to a mold in the center.

GATE, RUNNER - A horizontal channel for running metal into the mold cavity.

GATE, SLOT - A gate used on vertical cylindrical castings in which the down sprue and castings are connected over a large part or all of the height of the casting.

GATE, STEP - A gate which allows entrance of the metal into the mold in steps.

modern castings

FOUNDRY FACTS NOTEBOOK

Gating Solves Traffic Jams

FOUNDRY FACTS NOTEBOOK is designed to bring you practical down-to-earth information about a variety of basic foundry operations. As the name implies, this page is prepared for easy removal and insertion into a notebook for handy future reference.—Editor

By VINCENT H. FURLONG
Regional Manager
Foundry Services Canada, Ltd.
Oakville, Ont.

Foundrymen who are consistently having trouble with the gating and riser of their castings could possibly learn a little from our highway engineers. With all the new highways, intersections and overpasses going up all over the country one is pleasantly surprised with the speed that one can get from A to B, the freedom of traffic jams and the ease of getting from a side road onto a main highway by the use of a feeder line.

All this free flowing traffic has resulted from a careful study of the speed and movement of freely flowing objects or masses. When one stops to consider it the analogy between traffic jams on the highways and bad gating of a casting are very similar. The causes and cures for both are so closely related that a study of a plan or photograph of a main highway, feeder lines and overpasses looks much like a blue print of a well designed casting.

The five main points to remember in gating a casting or laying out a highway intersection are:

1) Avoid sharp corners. Traffic has to stop before proceeding and it therefore piles up behind. The intersection road wears badly and pot holes appear. Where metal is changing course at a ninety degree angle a swirling action is encountered at the corner causing oxidation of the metal with resultant oxide inclusions in the casting. Further erosion of the sand mold will cause sand inclusions in the

casting. Well rounded corners will however result in a free flow of traffic or metal as the case may be.

- 2) Avoid level crossings. A train usually makes a mess of an automobile at a level crossing. Similarly two streams of metal meeting at different velocities or in different volumes usually makes a mess of the resultant casting.
- 3) Improve road surfaces. A dirt road or one that is a mass of pot holes will soon ruin a good automobile. Similarly a rough sand mold will not help produce a smooth casting. A sand with an AFS grain fineness of 25 to 30 is the dirt road and the one with a fineness of 70 to 150 is the super highway.
- 4) Provide good road foundations. A smooth layer of tar on a bad road foundation will spoil quickly. Similarly a bad molding sand will not always support a mold dressing. It is generally better to improve the physical properties of the molding sand and then as a final consideration add a mold dressing.
- 5) Avoid heat attack. Do not use a material which will be affected by a hot sun, otherwise a bad surface will result and pot holes will appear. Similarly make sure

that the hot toughness of molding sand is sufficient to withstand the metal which is being poured onto it.

Highway accidents cost lives as well as money and one usually considers that a scrap casting has only cost money. However a badly designed gating system and poorly controlled molding materials often results in low physical properties of a casting which can in certain cases result in loss of life from castings breaking under strain or leaking under pressure.

So the next time an engineer shows you a casting design ask him if he would like to drive a car from the down sprue to the casting body. If he is hesitant it is a fair indication that the metal will not flow any more easily than an automobile. The engineer in his turn should look at the foundryman's sand control system. If it is as antiquated as the road systems of pre-war days then he should either insist on improvements or consider taking his castings to another foundry.

There are many ways of avoiding molten metal traffic jams in molds. Some of the gating systems that may help you get non-turbulent metal flow in your molds are shown on the next page.



In these four metal patterns for shell molding you will note the free-flowing traffic route provided by the well designed gating system.

GATING

TERMINOLOGY

CHART

Prepared by
GRAY IRON
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American
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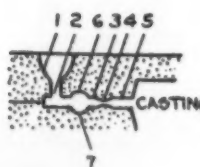
PARTING GATE



- A**
- 1 SPRUE CUP
 - 2 SPRUE
 - 3 SKIM BOB
 - 4 GATE (IN-GATE)



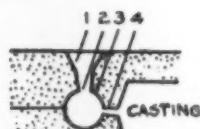
- B**
- 1 SPRUE CUP
 - 2 SPRUE
 - 3 GATE
 - 4 RELIEF SPRUE
 - 5 CHOKE (IN-GATE)



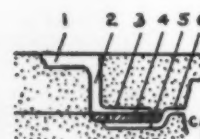
- C**
- 1 SPRUE CUP
 - 2 SPRUE
 - 3 GATE
 - 4 CHOKE
 - 5 GATE
 - 6 SKIM BOB (COPE)
 - 7 SKIM BOB (DRAG)



- D**
- 1 POURING BASIN
 - 2 DAM
 - 3 SPRUE
 - 4 GATE
 - 5 CHOKE



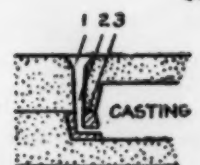
- E**
- 1 SPRUE CUP
 - 2 SPRUE
 - 3 SHRINK BOB
 - 4 GATE



- F**
- 1 POURING BASIN
 - 2 SPRUE
 - 3 STRAINER GATE (TOP)
 - 4 STRAINER GATE (CORE)
 - 5 STRAINER GATE (BOTTOM)
 - 6 GATE



- G**
- 1 POURING BASIN
 - 2 SPLASH CORE
 - 3 POURING BOX
 - 4 SPRUE
 - 5 GATE



BOTTOM GATE

- H**
- 1 SPRUE CUP
 - 2 SPRUE
 - 3 CORE GATE

BRANCH GATE



- I**
- 1 SPRUE
 - 2 RELIEF SPRUE
 - 3 RUNNER
 - 4 FINGER GATES
 - 5 FLAT GATE

PENCIL GATE



- J**
- 1 POURING BASIN
 - 2 PENCIL GATE

HORN GATE



- K**
- 1 HORN SPRUE
 - 2 CHOKE

TOP GATE



- L**
- 1 POURING CUP
 - 2 CUP STRAINER CORE
 - 3 SPRUE

FINGER GATE



- M**
- 1 SPRUE
 - 2 FINGER GATE

WEDGE GATE



- N**
- 1 WEDGE GATE
 - 2 CHOKE

RING GATE



- O**
- 1 SPRUE CUP
 - 2 SPRUE
 - 3 RING GATE

WHIRL GATE



- P**
- 1 SPRUE CUP
 - 2 SPRUE
 - 3 RUNNER
 - 4 POOL
 - 5 RELIEF SPRUE
 - 6 GATE
 - 7 RISER

GATE STRAINER - A gate designed to prevent slag and dirt from entering the mold and also to control the rate of which metal enters the mold cavity.

GATE, SWIRL - A gate used with a feeder and runner designed to swirl the metal in the feeder to remove impurities.

GATE, WEDGE - A gate the shape of a wedge feeding directly into the mold cavity.

GATING SYSTEM - The complete assembly of sprues, runners, gates and individual casting cavities in the mold. Term also applies to similar portions of master patterns, pattern die, patterns, investment mold and the finished casting.

PENCIL GATE - Gating directly into the mold cavity through the cope by means of one or more small vertical gates connecting the pouring basin and mold cavity.

RELIEF SPRUE - In a mold a vertical channel, the approximate size of the downsprue connected to the runner to relieve pressure surge during pouring. It functions like a standpipe in a plumbing system.

RUNNER - A channel through which molten metal or slag is passed from one receptacle to another; in a mold, the portion of the gate assembly that connects the downgate or sprue with the casting ingate or riser.

RUNNER BOX - Device for distributing molten metal around a mold by dividing it into several streams.

RUNNER EXTENSION - In a mold, is that part of a runner which extends beyond the farthest ingate as a blind end. It acts as a dirt trap since the first rush of metal along the runner will pick up any loose particles of sand or dirt and carry them into the extension and not into the mold cavity.

RUNNER RISER - A conventional runner, usually in the horizontal plane, which permits flow of molten metal to the ingate and is large enough to act as a reservoir to feed the casting.

SET GATE - Gating systems formed by patterns, in contrast to gates cut in the sand by hand.

SHOWER GATE (PENCIL GATE, POP GATE) - In a mold, a gating system by which metal showers into the mold cavity from a group of small gates at the top.

SKIM-BOB - In a mold, a small upward bulge in the ingate an inch or two from the casting which acts as a dirt trap.

SKIM GATE - A gating arrangement which changes the direction of flow of molten metal and prevents the passage of slag and other undesirable materials.

VENT - A small opening or passage in a mold or core to facilitate the escape of the compressed gases when the mold is poured.

WHIRL GATE - A gate and sprue arrangement which tangentially introduces molten metal into a riser so the centrifugal action forces dirt or slag to the center of the riser and away from the riser connection as the metal enters the casting cavity.

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Circle No. 992, Page 7-8

Three Levels of Foundry Technology

The other day a bolt broke on a piece of our foundry equipment. When I asked the shop repairman why he thought the bolt had broken, he said, "It must have been lousy steel because the darn thing crystallized." His solution—get better bolts.

When the broken pieces of the bolt were sent to the metallurgical laboratory, it was discovered that the "failure was a fatigue fracture caused by a moderate overstress with a high stress concentration present in a two-way bending load." Their solution—obtain a bolt of higher tensile strength and lower notch sensitivity.

Had this been taken one step further into the field of theoretical metallurgy, a man like Dr. Zener, director of the Westinghouse Research Laboratories, might have said, "The failure was due to a coalescence of dislocations which lead to the forming and propagation of micro-cracks." His solution—make a steel without grain boundaries so that dislocation clusters have no weak films to impinge upon.

In this illustration we see three different answers to why the bolt broke and three different suggestions as to how to overcome a possible recurrence. Strangely, all three answers are right and all three solutions are good, yet in a certain sense all three are the same.

Had the shop mechanic said, "The bolt broke because it was made of steel, and steel being of crystalline structure has its weaknesses," his statement would have been fairly close to that of the theoretical metallurgist. He could understand a bolt breaking without thinking in terms of atomic vibrations, gliding dislocations and vacancy condensations. In fact, he could understand a bolt breaking without even thinking in terms of hardness, endurance ratio, fatigue strength and overstress.

A similar situation exists in the field of foundry technology. Technology should be visualized as operating on three distinct levels. First, somewhere behind the scenes there are theoretical physicists and metallurgists, mathematical economists, ceramics engineers, organic chemists and a host of related occupations in which foundry technology is being conceived. These so-called pure scientists may have no intention of using their ivory towers as pilot plants in which to test ideas and processes which will shape tomorrow's foundries. Nevertheless, a substantial portion of foundry technology has its origin in pure science. While the foundry industry may hesitate to



D. N. ROSENBLATT
Chief Metallurgist
American Foundry &
Machine Co.
Salt Lake City, Utah

acknowledge this fact, it is from this level that new horizons in foundry progress become the most promising.

The second level is an impressive and growing middle ground of technology. This level is occupied by technical societies, such as AFS; manufacturers of foundry equipment and supplies, with their research, development and educational facilities available to the foundry industry; technically competent sales engineers; consultants; and independent research and engineering organizations. We find appearing at this level whole new departments, such as industrial engineering, methods engineering and quality control. The mid-level of foundry technology is the area from which we must draw to initiate any new practice or process, or to effectively put more control into an old one.

Finally, we have the third level of technology which concerns the foundry worker directly. This might be called the operating level and rightly belongs more with the line foreman than with the individual worker. At this level, technology is actually applied to production. The nature of the contact largely determines the success of any technological plan, no matter how carefully conceived and refined on the foregoing two levels just described. This is the area of harsh reality, the proving ground of practicality, and the reactor where a mathematical equation must be skillfully blended with the human equation.

"In the face of deteriorating business in heavy manufacturing, the months ahead place the foundry industry in a tenuous position which will see management reluctant to pursue expensive technological programs. Nevertheless, in at least some foundries, their very survival will depend upon management having a clearer understanding of foundry technology. By skillfully applying money-saving ideas which have been carefully filtered through these three levels of technology, the foundry will be able to hold its basic position in our future industrial economy."



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Circle No. 993, Page 7-8

May 1958 • 197

FIRE INSURANCE STORY GENERATES HEAT

■ "Co-Insurance—80% of What?" an article on fire insurance written by Kenyon D. Love, Colonial Foundry Co., Louisville, Ohio, and published in the February MODERN CASTINGS has generated some interesting and heated replies.

The first comes from N. A. Ulseth, Bronson Dennehy Ulseth Inc., a Chicago insurance firm. Mr. Ulseth writes that the article "is challenging in that there are some inconsistencies based

on personal opinions which are debatable."

Among these, he states, is the fact that "rules of insurance are different in various parts of the United States. Some of the statements in the article are wrong as far as, at least, the Middlewestern states are concerned. It is unfair to compare buying an intangible such as insurance with a staple item such as pig iron."

Mr. Ulseth also writes that "The

subject of the Co-insurance Clause is elusive and sometimes misunderstood, but we doubt that it is misunderstood in the degree expressed in this article."

Another insurance man who took exception to the article was Eugene I. Morris, the Morris Agency, South Orange, N. J.

Mr. Morris writes that author Love's statement that "if you buy 80 per cent co-insurance, you are agreeing to accept a settlement for 80 per cent of the damages, in the event of a total loss, and to insure yourself for the remaining 20 per cent" is not true. He states if the insurance purchaser buys proper coverage, he will receive full benefit of the policy, not 80 per cent of the face amount of the policy. "Co-insurance," he states, "does not mean that a man cannot purchase full value on a building. It is only used as a method to properly ascertain approximate value."

Mr. Morris also adds that the author "doesn't know enough about the

insurance business or the contracts to be an expert on giving insurance advice."

E. F. Hines, foundry manager, Nemco Foundry, Tulsa, Okla., writes as a satisfied owner of a co-insurance policy covering a metalcastings plant. The fire which recently damaged the Nemco plant was also described in the February MODERN CASTINGS.

Mr. Hines writes that the building "had been appraised by the insurance company about six months prior to the fire. We were carrying the amount of insurance recommended by the insurance company in order to comply with the 80 per cent co-insurance clause and therefore we collected the actual cost to rebuild with the exception of reasonable depreciation."

The stock, machinery and equipment in the plant were covered by a special all-risks policy and foundry records were protected by a valuable papers policy.

Mr. Hines states that "All in all, we were very pleased with the way our insurance worked and in retrospect, we would probably have set it up exactly the way it was even if we knew we were going to have a fire."

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1200-Ton Die Casting Machine Produces V-4 Outboard Blocks

■ A new 1200-ton die casting machine capable of casting up to 47-1/2 lb of aluminum, has been installed at Johnson Motors Div., Outboard Marine and Mfg. Corp., Waukegan, Ill.

This is the largest machine that was ever built employing the unit frame principle, according to the producer, Lester-Pheonix, Inc. Frame and platens were cast and finished in West Germany at the plant of the Lester licensee, Maschinenfabrik Weingarten. They were then shipped to Johnson Motors, via the St. Lawrence River, where the balance of the components, fabricated in the manufacturer's plant in Cleveland, Ohio, were assembled.

The one-piece cast alloy steel frame holds a movable die plate 72-in. wide and 55-in. high and can accommodate a maximum die height of 50-in. The toggle locking mechanism of the machine allows a die opening adjustable from 10-1/4 to 36-in. Maximum shot pressure available on the machine is 20,300 psi.

Central die height adjustment is accomplished on this giant machine by means of an electric motor mounted on the frame. Among other features of the machine are a pre-fill

injection system, adjustable shot position (from 4 in. below center to 14 in. below center), automatic grease lubricating system, and automatic hydraulic ejection. 11,000 cu in. capacity nitrogen accumulator is also supplied with the machine. The angled support bars of the injection end were designed to dovetail with an automatic ladling furnace.

The clamping tonnage of this machine was established by strain gages on a load ring calibrated at the National Malleable Casting Technical Center. The full 1200 tons of clamp was developed at only 60 per cent of the maximum pump pressure.

The Manufacturer states that this machine, can easily produce the largest commercial die castings in production anywhere in the world today. The machine is being used by Johnson Motors to cast housings, motor blocks and other components of their new line of V-type outboard motors.

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for new ideas?

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Bentonite Tests

Continued from page 179

TABLE 1—VARIOUS PROPERTY VALUES

Sample	Moisture (%)	Liquid Limit	pH	CaO (%)	Plastic Viscosity
1	6.7	685	9.4	0.40	13
2	7.5	675	9.5	0.31	21
3	7.3	605	9.35	0.15	12
4	9.6	595	8.8	0.57	10
5	6.2	458	9.7	0.62	5
6	6.0	405	8.9	0.69	5
7	4.7	395	9.0	1.13	5
8	6.3	387	9.2	0.135	4

Swelling Test	Gel Strength	Green Tensile	Green Compression	Green Shear	Hot Strength
42	110	8.6	5.6	1.3	8.6
40	60	10.8	6.1	1.6	9.2
31	24	6.2	4.4	0.9	6.2
38	47	9.2	5.7	1.2	7.6
30	35	8.8	5.9	1.3	7.3
27	45	8.5	5.4	1.3	7.4
20	23	3.8	3.3	0.8	3.5
23	2	2.8	4.0	0.9	3.3

Samples 1-8, Continued

a minimum of 525. The slurry mixer, Fig. 1, mixes dry bentonite and water; to thicken the slurry, more bentonite is added. Grooving of the slurry in the test cup is also shown in Fig. 1.

Low CaO content

A table of values for the eight test samples, Table-1, arranges the samples in order of decreasing liquid limit. In samples 3 and 8, the sodium content could be 2-6 times the calcium content and still be less than one per cent, which undoubtedly accounts for their unsatisfactory results in sand mixtures. We must watch our very low CaO contents as well as the high ones.

Samples 1-4, pass all specifications, while 5-8 fail to meet the WL specification and, in some cases, exceed the maximum CaO content.

Column 6 shows the gel strengths which do not necessarily indicate the quality of bentonite for a steel foundry bond. Low gels are desirable for pumping in slurry systems and used mostly in high-production iron shops.

All tests based on sand mixtures are affected by sand variables—grain size, grain distribution and particle packing in the specimen. Such tests apply only to conditions at the time of the test.

Regulate Sand Mixes

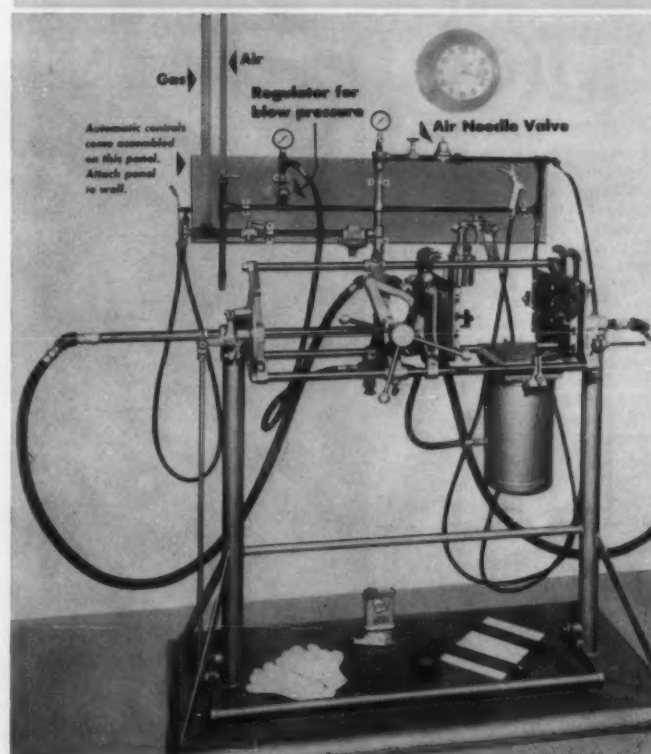
We like our green tensile high, 9 or 10 ounce per sq in. maximum; then we can regulate our sand mixes accordingly. The type of casting produced and the methods employed in the individual foundry will dictate the properties most desirable.

We feel that it is advantageous to purchase and qualify our bentonites under S.F.S.A. specifications; but we will continue to run our green and dry strength tests to avoid a situation as in sample 3.

Presented at Southeastern Regional Foundry Conference.

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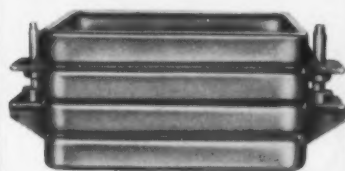
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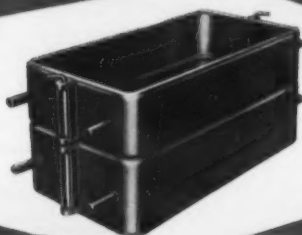
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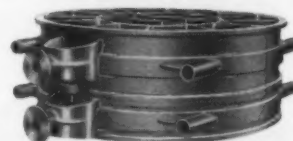
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Circle No. 996, Page 7-8

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For Mechanized ferrous foundry in Midwest. Must be experienced in gating. Have knowledge of Standard Costs. Supervise all molding operations. Submit confidential resume. Box E-24, **MODERN CASTINGS**, Golf and Wolf Roads, Des Plaines, Ill.

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A large production jobbing foundry needs an experienced, capable man to supervise the Core Department. He must have supervisory experience in a similar operation as he would be in charge of three foremen and approximately ninety workers. This job requires technical core room knowledge plus considerable scheduling and administrative ability. This well established foundry is a leader in its field and is interested in only the most well qualified people available. Address replies to Box No. E-27, **MODERN CASTINGS**, Golf and Wolf Roads, Des Plaines, Ill.

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An aggressive mechanized gray iron foundry in the midwest area desires a qualified foundryman to take over and direct their Quality Control program. Must be well experienced in metallurgy, cupola operation, sand control and general foundry operation. Prefer a man with B.S. or B.E. degree, between 35 and 45 years of age. This is an exceptional opportunity for the right man. Address replies to:

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ENGINEER, Manager seeks substantial interest in small foundry operation, participation optional. E-26, **MODERN CASTINGS**, Golf and Wolf Roads, Des Plaines, Ill.

Positions Wanted

FOUNDRY METALLURGIST, BS in Metallurgical Engineering 1953, 5 years experience seeks position with greater responsibilities in medium-sized gray iron foundry. Experience includes casting development, cupola practice, sand control, and heat treating. Box E-20, **MODERN CASTINGS**, Golf and Wolf Roads, Des Plaines, Ill.

TWO SWEDISH FOUNDRYMEN returning to U.S. in July are seeking jobs Prefer West Coast, 5 years of previous employment in U.S. Good references. A. **PRODUCTION SUPERVISOR**, 40, 24 years in foundry business, 13 years as Supervisor. Ferrous and non-ferrous. Mechanized and jobbing shops. Experienced in all phases of foundry work. Desires a position as foreman or superintendent. B. **ENGINEER**, 35, 12 years in foundry business. Plant engineering, equipment design, projecting, maintenance and quality control. Desires position as Plant Engineer or similar. E. Andersson, Stenvägen 8, Skovde, Sweden.

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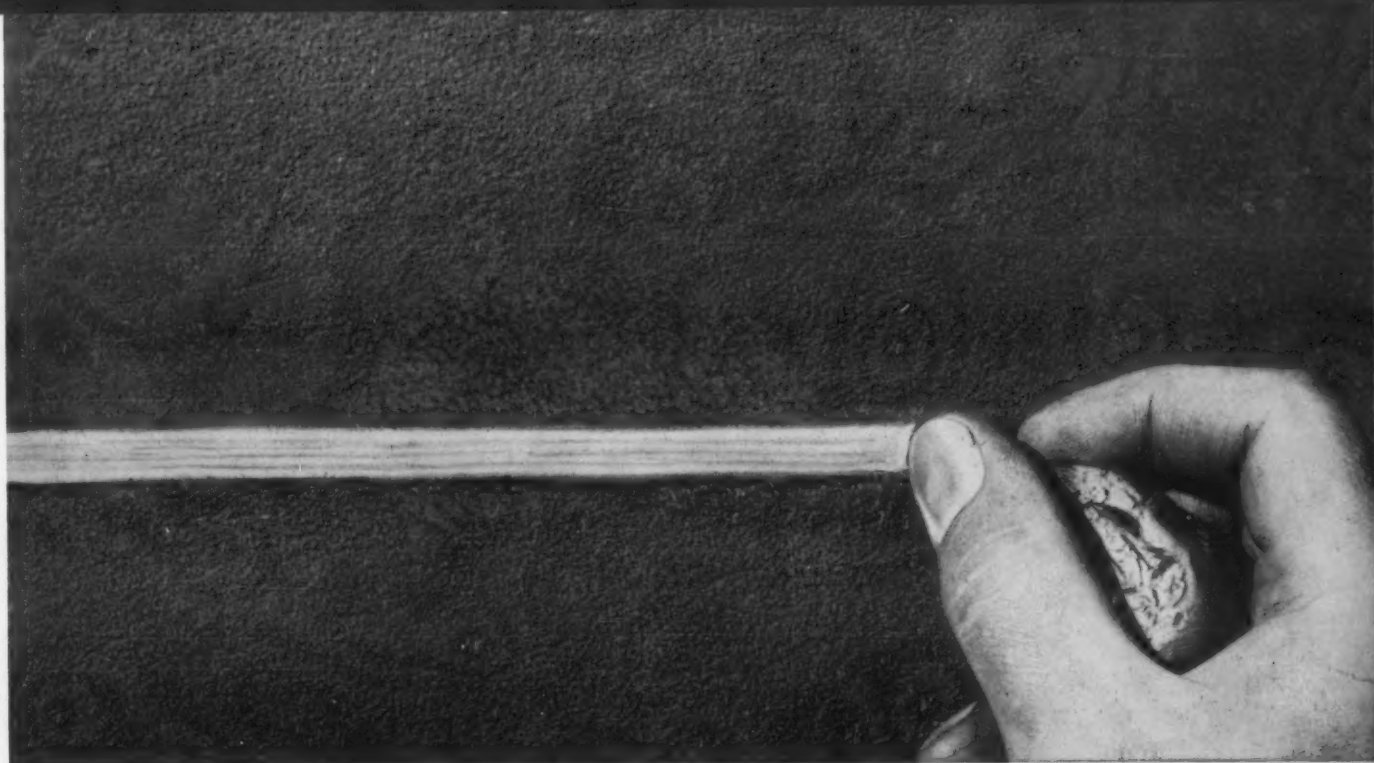
New Publication Discusses Testing of Thermocouples

■ Methods of testing thermocouples and thermocouple materials are described in a new National Bureau of Standards Circular. The publication points out certain precautions that must be observed if reliable results are to be obtained from measurement and control of temperature, essential to a uniformly high-quality product. Recognition of this fact has led to increasing use of temperature-measuring equipment in recent years.

Emphasis is placed on calibration of platinum versus platinum-rhodium, copper-constantan, Chromel-Alumel and iron-constantan thermocouples. Guidance is provided in selecting a test method best adapted to a given set of conditions. Calibration at freezing points, melting points and boiling points is covered as well as calibration by comparison methods. Accuracies obtained in calibrating various types of thermocouples by different methods are presented in table form.

The circular is available for 20 cents from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C.

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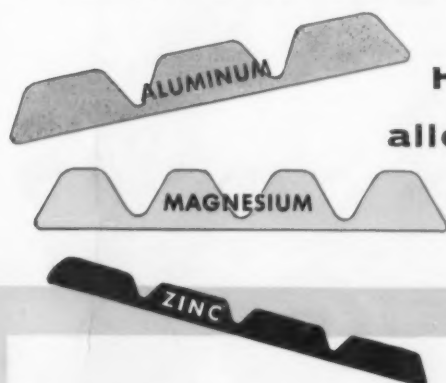
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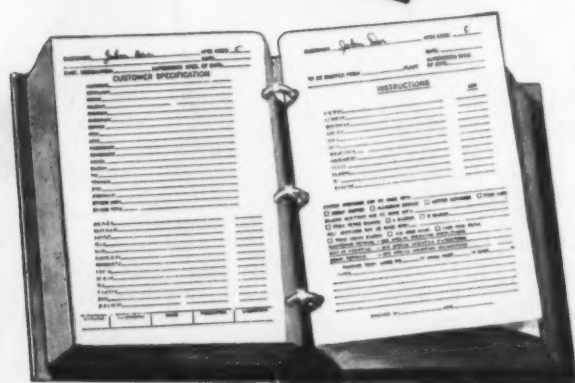
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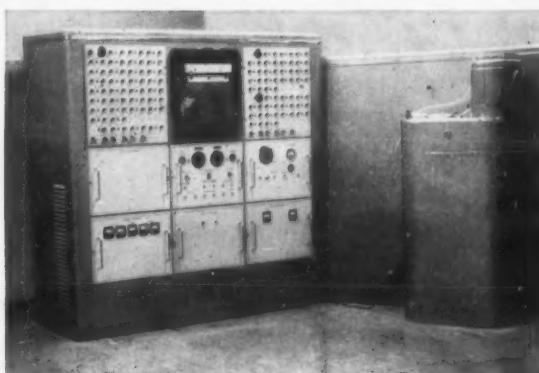


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